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THE HIGH CURVES OF RAILWAY RECEIVERSHIPS.

Some four years and a half ago (August 5, 1904) we pointed out in these columns certain features of the three preceding periods of high curves in railway receiverships. The first period, dating back to 1876, was incomplete as it did not include the panic year 1873 and the two years after for which no returns are available. But the returns did include five years of the "long drag" ending in 1880. The three intensive periods in condensed form are set forth below:

First Period.

Year.	Miles.	No. of roads.	Stocks and bonds.
1876	6,662	42	$467,000,000
1877	3,637	38	220,294,000
1878	2,320	27	93,385,000
1879	1,102	12	39,367,000
1880	885	13	140,265,000
Total	14,606	132	$960,311,000

Second Period.

Year.	Miles.	No. of roads.	Stocks and bonds.
1883	1,990	11	$108,470,000
1884	11,038	37	714,755,000
1885	8,286	44	385,460,000
Total	21,314	92	$1,208,685,000

Third Period.

Year.	Miles.	No. of roads.	Stocks and bonds.
1892	10,508	36	$357,692,000
1893	29,340	74	1,781,046,000
1894	7,005	38	395,791,000
1895	4,089	31	369,075,000
1896	5,441	34	275,597,000
Total	56,383	213	$3,179,201,000

The fourth curve falls in the "panic year" just closed—only it is not, strictly speaking, a curve so much as a sharp upward angle whose inclosing lines fall thus far, or nearly so, within a single year, 1908, when the receivership mileage has been 8,009, the number of railways 24 and stocks and bonds $596,359,000. What the present year will bring forth is, of course, uncertain. But the outlook favors decidedly the close of a sudden and sharp but brief receivership period.

Comparison of the periods and their coefficients are interesting. In a rough way it will be noted that, taking the long panic aftermath following 1873 as a basic line, the high curves of receiverships come about ten years apart, with 1907 somewhat longer removed. This may have slight significance. But the coincidence would have been closer if the prophecies of woe in the height of speculation some three years ago had been fulfilled—and there was another time of doleful prophecy three or four years before that. Both those epochs of speculative expansion were survived without panic and when the panic year, now presumptively in its past tense, came it left relatively few wrecks upon the shoals. Compare, for example, the $596,359,000 of stocks and bonds in the receiverships of 1908 with the $467,000,000 of 1876, when the railway interest of the country was much smaller than now, or, under similar conditions, with the $714,755,000 of 1884, or the $1,781,046,000 of 1893. It was not many years ago when, under the evil auspices of "holding companies" and "high" finance with stock recapitalized into mortgage bonds it looked as though the next receivership period would be fraught with profound and widespread disaster. Inflated bonding, it was reasoned plausibly, spelled foreclosure when hard times reduced the railway earnings for the bonds which had once been stock without foreclosure power. Yet that prophecy has gone unfulfilled, too, though one or two of the big "high financed" systems have been badly jarred. So also with the street railways. Their enormous and often reckless over-capitalization in bonds as well as stock seemed a clear prognosis of foundering when the first financial tempest swept the fiscal sea. Yet if we exclude the notorious New York Interborough example—where wreck would doubtless have followed, panic or no panic—and one or two minor cases the survival of the street railways has been remarkable.

Looking back over the first three periods of high curve receiverships and allowing over-speculation as a general cause of each there appear only two or three elements of a special contributory character. There were the frenzy of railway building that brought on the panic of 1873—with the granger agitation as a minor component—and the silver question in 1893 and after. But in none of the three periods was there such an aggregation of new contributory causes as in the year just past. Add to abnormal speculation state railway baiting and to that federal interference and a presidential election to both and the revision of the tariff to the three one finds such a combination of sinister forces as challenged the most exalted mood of the optimist. Yet that optimist is still atop and promises to remain there, and his reasonings why acute conditions of railway calamity have been but sub-acute in the sequel are proving sound. When he tells us of solid underlying bases of American industry, of the massed capital that resists the harder impacts and onsets of panic, of the consolidated railway interests and organizations which protect their weaker lines we begin to believe him—even in the face of revived Wall street speculation—and to understand why the panic harvests of 1908 fell so far, in terms of railway receiverships, below the dismal reapings of the decades before.

THE NEW HAVEN ELECTRIFICATION.

The paper read by W. S. Murray before the Institute of Electrical Engineers and published a week ago in this paper was so remarkable in its presentation of the subject and so valuable in the matter which it contained that it was well within the bounds of expectation that it would call forth a full and vigorous discussion. This expectation was fulfilled, as will be seen from the abstract appearing in another column this week. When we remember the storm of criticism, amounting at times to prognostications of it-can't-be-done, when the proposition to electrify the New Haven line with the single-phase system was proposed, it would be strange if all interested engineers should have been willing to accept Mr. Murray's frank exposé of his troubles and of the means taken to meet them, coupled with the statement of current conditions, as a demonstration of the complete success of single-phase design and operation. Hence, differences of opinion still exist as to the relative electric and economic merits of the rival systems.

It was agreed universally, however, that the presentation of the subject was novel and of great importance and usefulness. As one speaker put it: "The ordinary man is usually so bent on having his work given the greatest amount of credit that his best endeavors are put forward in advertising the beauties of his work and concealing the blemishes thereof. It is, therefore, certainly most radical, not to say startling, to have an engineer feel so sure that the beauties of his work will be properly appreciated that he is content to pass them over with but scant mention, and by taking the directly opposite course at great pains, and even in minute detail, to exploit and expound upon the blemishes."

Nearly every speaker had something to say upon this point, and with their commendation was expressed the desire that some officer of the New York Central would go and do likewise. If this were to be done, the enginering world would be in a far better position to pass judgment and come to a decision as to the relative merits of the two systems than it is at present, or can be until enough time has elapsed to show by natural selection which is fitter to survive.

It is probable that each has its natural field of operation, in which the other will be unable to compete either economically or electrically. In reply to the criticisms of the New Haven failures attention was repeatedly drawn to the short haul on the New York Central, in that, up to the present, this company had been called upon to perform little more than a switching service, so that its work was not comparable with the longer and faster runs that are being made on the New Haven.

Much of the discussion swung around the cost of installation, and again and again the direct current men returned to the charge, but their figures were estimates based on other estimates that resolved the whole in a mass of uncertain guessing that proved nothing and convinced no one. But even had their hypothetical figures been based on certainties it would have to be borne in mind, as one speaker put it, that "the final test is not the cost of installation, but the ratio between the receipts and the coal pile."

In many respects the discussion partook of the character of arguments pro and con regarding the two types of motor by their respective adherents, especial emphasis being placed by the party of direct current on the greater tractive power per ton of weight of the New York Central locomotive, which was met by the claim of greater torque at high speeds of the single-phase motor.

Taking the discussion as a whole, and regarding it solely from the position of a disinterested outsider, it is evident that the paper has made a profound impression upon the electrical engineers to whom it was addressed. It has shown them that the possibilities of single-phase operation are much greater than many of them supposed to be possible a few years ago, and while the advocates of direct current operation are not yet willing to concede an equality to the alternating current machine, they are, at least, obliged to admit that great advances have been made, and that the end is not yet.

The outsider, too, who has come into close contact with the operating officers of the two roads, knows that while each expresses himself as satisfied with what has been done and feels that the period of worry has been passed, there is still a sense of much to be accomplished before all will be well. They know that the electric locomotive has developed track stresses of great magnitude at high speeds that are still imperfectly understood, and that these stresses must be guarded against by lowering the maximum speed limit and using a track construction that for strength is probably unrivaled, and for cost of maintenance undoubtedly outranks anything heretofore in use. Such things as these, however, the railway officer and the engineer expect, for each knows the infrequency with which first efforts are crowned with solid sucess. They know that all of these great undertakings reach their final triumph through a long series of trial and error, and that there is no other path leading to the goal. It is quite safe to say, therefore, that it is the consensus of opinion of all who took part in the discussion of Mr. Murray's paper that it was a bold step on the part of the New Haven management to brush aside the tremendous array of obstacles arising from the paucity of data regarding single-phase operation and requirements and launch at once into the unknown waters of trunk line operation on so large a scale, where failure would have been disastrous. By so doing, and by its display of courage in overcoming difficulties and placing operation on a satisfactory footing, the New Haven company has rendered a service of great value to electrical and to railway science in demonstrating at least some of the possibilities of single-phase traction. The New Haven officers chose the single-phase system because they believed that the direct-current locomotive is not suited for trunk line work. As Mr. Murray said in his closing remarks: "The electrification of the New Haven road was not taken up as a terminal proposition in any way whatever, but was intended to have its application to long-distance work."

COMMODITY VALUES AND FREIGHT RATES.

In its opinion in the case of the Stowe-Fuller Company *v.* Pennsylvania Company, *et al*, the Interstate Commerce Commission said that "classification must be based upon a real distinction from a transportation standpoint"—that "to hold otherwise would be to promote false billing on the part of shippers." It was assumed that the Commission meant to condemn the basing of rates on commercial as distinguished from transportation considerations. The later opinion in the case of Union Pacific Tea Company *v.* Pennsylvania Railroad, *et al*, indicates that this inference was incorrect. In the latter case the Commission said:

> "While we now decline to establish this rating upon the basis of value, it must not be understood that we have reached a final conclusion that such a principle might not with propriety be introduced into the classification of these articles. There is much to commend the idea. . . . If the carriers could suggest a workable plan which would accomplish this it would probably meet with the approval of the Commission. . . . The value contemplated by such a classification would not be a release value, but a declared value. The value as stated by the shipper would be a part of the description of the property."

There is nothing novel about basing rates on the value of commodities. The minimum and maximum between which rates must be fixed are the cost of the service and the value of the service. A railway cannot afford to haul a commodity for $50 if hauling it will add $51 to operating expenses. A shipper cannot afford to pay $50 for the transportation of a commodity if it will be worth only $49 more in the market than at the shipper's farm or factory; the cost will exceed the

value of the service. Now, the value of commodities is a most important factor in fixing both cost and value of service. The more valuable a commodity is, the larger are the claims the railway has to pay for loss of or damage to it, and the higher therefore is the average cost of hauling it. The less valuable a commodity is the less is its value per ton increased by moving it from one place to another; the less is the value of the service to the shipper; and the smaller is the maximum rate he can afford to pay. Conversely, the less valuable a commodity is the less a railway can afford to haul it for, and the more valuable it is the more a shipper can afford to pay for having it hauled.

The principles stated are so obviously true as to be axiomatic. They are tacitly recognized in every tariff or classification made by either railways or commissions. But railways do not, in practice, carry these principles to their logical conclusion; and when they try to approach nearer to doing so, commissions are apt to oppose them. Commissions are strongly prone to give preponderant weight to cost of service and to neglect value of service, although the latter is the more important factor, not only in scientific rate-making, but in fixing prices in every commercial business. The railway is analogous to a manufacturing concern, such as a packing house, that makes a number of articles. Theoretically, perhaps, the packer can tell how much it costs him to make fertilizer and porterhouse steaks. But in actual practice he buys a steer, horns, hair, hoofs and all, for a stipulated price per 100 lbs. By the manufacturing process, part of the steer is made into fertilizer and part of it into porterhouse steaks. The fertilizer is sold for a price a little above the cost that would not have been incurred if it had not been made, while the porterhouse steaks bring far more than the average amount per 100 lbs. it has cost to prepare the carcass for market. The value of the service of making fertilizer is less than the value of the service of making porterhouse steaks. If the packer tried to base his prices on cost he would have a big demand for steaks, but no demand for fertilizer. Similarly, if the railway tried to base its rates on average cost it would have a big demand for short hauls and for the transportation of such commodities as dry goods, but it would have no demand for long hauls and for the transportation of such commodities as coal and lumber.

If due weight were given to the value of commodities many articles in the classifications would carry very different rates from those they carry now. The average number of tons of coal per car shipped between Pittsburgh and Chicago by a certain large manufacturing concern in the year ended June 30, 1908, was 49.3. The average rate paid was $1.90 per net ton, making the average earnings per car $93.67. The average carload of merchandise between the same points was perhaps 15,000 lbs. and the first-class rate 45 cents per 100 lbs., making the earnings per car about $68. Earnings per car from one of the least valuable commodities were more than from one of the most valuable. We have heard shippers complain that class rates in eastern territory have stood unchanged for years. A fairer criticism probably is that in proportion to the value of the commodities and to earnings per car class rates are too low as compared with rates on many commodities outside the classifications.

Both the cost of the transportation service to the railway and the value of the service to the shipper are affected by changes in the value of commodities. A logical application of the principle of basing rates on the value of commodities would involve raises or reductions of rates as the value of commodities advanced or declined. No one would argue that rates should be changed with every slight fluctuation in the price of a commodity; but when changes in prices are not merely fluctuations, but are substantial and lasting, there should be also changes in railway charges. Inflexible schedules of rates are apt to be unduly burdensome to commerce in periods of low prices and unremunerative to the railways in periods of high prices.

It is not clear whether the Interstate Commission in its opinion in the Union Pacific Tea Company case meant to invite consideration of the entire question of the proper relation of the value of commodities to rates; but the question is one that highly merits more intelligent consideration and application than it has had.

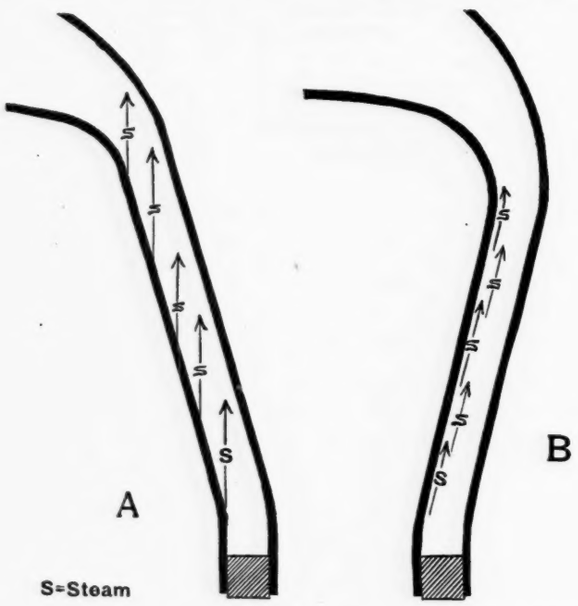
THE LIFE OF WIDE FIREBOXES.

The firebox, 60 to 70 inches wide, for bituminous coal burning locomotives, has been a continued source of trouble on most railways on account of broken and leaky staybolts, leaky tubes and cracked sheets. The repairs to side sheets in many of them have been so extensive that the boxes have been removed after a service of two or three years and in many instances this life has been only one year. While various theories have been advanced to explain these failures, the relation of the life of the side sheet to its shape has not been so definitely settled as to make much impression on firebox design and it does not appear to have been considered of much importance. The fact that the older fireboxes having O. G. shape, with the side sheet inclining out from the mudring, has suggested the possibility that the difference in the steam and water circulation in fireboxes having side sheets inclined in and those having them inclined out, may account for the large difference in the life of the side sheets in the two types of boxes, and this may have some important bearing on future firebox design. There appears to be no settled practice in this regard, but the majority of wide fireboxes incline inward following the general contour of the outside sheet but at a smaller angle. In modern practice, however, may be found side sheets inclined out to a moderate degree; some vertical, and many nearly vertical, inclined either out or in. Thus the Harriman common standard boiler for Atlantic and Pacific engines has the side sheet inclined in, that for the consolidations, inclined out, and for switchers the O. G. form. On the Canadian Pacific they incline in on the Pacific engines and out on the consolidation. The new boilers with combustion chambers for the Northern Pacific and those for the St. Paul have the side sheets inclined out.

The number of wide fireboxes which have been renewed in the United States during the past two or three years is so large that the old ones would cover many acres, and if all of them were collected on the open prairie they would make an impressive spectacle which should result in some serious investigation as to the cause and a modification in firebox design which would largely prolong their life. The expense connected with such an investigation would be but a small portion of the amount spent for new fireboxes every year. The determination of the best shape for a locomotive firebox to insure long life for the sheets is a question which involves a correct knowledge of the circulation of water in locomotive boilers, and locomotive builders and motive power officers are alike at sea in their ideas regarding this important phenomena. This was well illustrated in the discussion of Mr. C. A. Seley's paper on the "Life of Wide Fireboxes," at the recent meeting of the Western Railway Club, where there was such a difference of opinion as to how water circulates in a firebox that two speakers said without contradiction that "we know little or nothing about it."

The effect of the shape on the life of fireboxes was suggested in the discussion on "the proper size of water space in the sides of locomotive boilers," by Lawford Fry and others at the Master Mechanics' meeting in June, 1905, and as this involved theories in regard to the water and steam circulation we reproduce here the cut which illustrates the principle involved. Mr. Fry said "In diagram A the side sheet inclines inward from the mudring. The steam rises in vertical lines S S across the water leg and interferes with the descending current of water. If the evaporation is violent there is a tendency to blow all the water out of the water leg. In

diagram B the side sheets slope outward from the mudring and the steam rises along the inner sheet, as indicated by lines S S, giving the cold water a chance to descend along the outside sheet to take the place of the evaporated water. This is a definite statement which gives one theory of circulation and it assumes that there is an upward current of steam along the inner sheet and a downward current of water on the outside sheet. If this theory is correct the sheet in Fig. B would burn out first, as it would be covered with steam instead of water, the very condition favorable to overheating. It is more reasonable to think that there is a current of steam and water passing along the inner sheet in form B, and where the water leg is narrow, there is an upward current of water through the whole section and the supply is from below along the mudring. The velocity is greatest along the fire sheet and it draws water from the outer portion in a diagonal or curved upward line. If this explanation is correct then the shape B is the best as the steam bubbles are rapidly renewed by the constant inrush and scouring effect of the water current, as Mr. Seley suggests. His paper further implies that there may be some advantage in a narrow water



leg, as it would favor more active circulation, the higher velocity being due to a given volume of water passing through a restricted passage in a unit of time, while a larger passage would result in a more sluggish current.

This theory is based on the assumption that a definite volume of water must circulate past the side sheet, but it is not at all certain that it does; it is more likely that the restricted passage will retard the current and allow less water to pass. The sheets will be more effectually cooled when there is a large volume of water adjacent and ready for any circulation which the rise in temperature may induce. The Wootten boiler is a good illustration of this condition, as here the water legs are unduly enlarged and the circulation is good. For this reason we are inclined to differ with the author in his suggested advantage of a narrow water space. The benefit of a wide water leg in increasing the length of staybolts and largely reducing the number of broken ones is so great that one should hesitate to give it up for an uncertain theory as to circulation. In the Master Mechanics' discussion referred to, Mr. Fry said: "There are so many good reasons for the use of wide water spaces that it is strange that the width has not been increased more rapidly. It is obvious that a free circulation of the water will be insured by wide water legs and they will help the evaporative powers of the firebox." Professor Goss said: "We all agree that we are not likely to get the water space too wide at the mudring, as a matter of principle the wider the better. There should be no contraction of the water space above the mudring but it should widen out."

The above is only an introduction to the discussion, and an investigation should be made on the proper design of wide fireboxes to insure long life to the sheets. The records showing the life and mileage obtained from fireboxes of various shapes should be collected in connection with the drawings so that some definite conclusions can be drawn. This should be followed by an investigation which would give us some positive knowledge in regard to the direction of the currents of water and steam in the circulation of locomotive boilers. Without such knowledge firebox design is largely guesswork so far as durability is concerned, and the recent experience with wide fireboxes is not a creditable record for locomotive designers and builders.

NEW PUBLICATIONS.

The Plane Table. By W. H. Lovell. New York: McGraw Publishing Co. 49 pages, 4¾ by 7¼ in.; 9 illustrations. Cloth. Price, $1.

From the introduction it is to be inferred that the author, who is a topographer of the United States Geological survey, wishes to extend the use of the plane table in this country by citing its advantages and its adaptability to a wide range of work. The criticism to be made of this work is that it partakes too much of the character of a reprint from a technical society paper in that it assumes an amount of information on the part of the reader sufficient to make him familiar with all of the minor details of plane table work. In short it is an intermediate section of a complete work. It skips all of the detail description of the instrument, and the principles upon which it acts, and plunges at once into the solution of a few problems and then stops short without one hint as to the uses and the means of connecting the several points that have been located, and it is only in the chapter on land surveys that one gets an inkling as to what should be done and even then the familiarity of the reader with the work is needed to make the text clear. If the text were to have been presented as a discussion of a paper on the subject, it would be considered a valuable contribution, but standing alone its incompleteness makes it of no value to a man who is ignorant of the construction and uses of the plane table and wants to learn of both; while, for the expert, the problems given and the notes accompanying them in regard to location, signals, flags and such auxiliary matters, are of little value other than mere reminders of things of which he already knows. So, while the contained matter is good as far as it goes, it neither starts soon enough or goes far enough to be of any great value.

Manual of Reinforced Concrete and Concrete Block Construction. By Charles F. Marsh and William Dunn. New York: D. Van Nostrand Co. 290 pages, 4 in. by 6½ in.; 113 illustrations. Leather, semi-flexible. Price, $2.50.

This manual is a condensation of the larger volume on reinforced concrete by the same authors, and its object is to give, in concise and handy form, the methods employed in the solution of common problems. It is an office pocket book and deals almost exclusively with the problems that arise in design. There are brief opening chapters on materials, construction and false work, water proofing and fine resistance, and then the book plunges directly into the calculations that are needed for the work in hand. It starts in computing loads on columns, piers and retaining walls, and broadens out to include such modifications as hoppers and bins with conical and spherical bottoms, and thus passes naturally to the consideration of the stresses in beams and girders, and then of floors and slabs. In the case of the latter it is frankly recognized that there is no accepted and satisfactory theory of the stresses in slabs supported on all edges. The generally accepted theory is that the maximum stress is to be found at

the center in two planes at right angles to each other. Beyond this the data depend on mathematical reasoning. The same confusion exists in the matter of the pressure upon retaining walls, and three theories are proposed: The first that the center of pressure always acts at one-third the height of the wall from the base, except where there is a surcharge; the second, put forward by J. C. Meem, and based on the well known fact that the pressure on the struts in a trench is always less towards the bottom than near the top and that the center of pressure is at a distance of one-third the height below the surface instead of the usually accepted position of one-third the height above the bottom, and the theory of E. G. Haines based on the assumption that slips of earth-works have always a plane of fracture forming a circular curve, and that the center of pressure is five-sixteenths the height of the wall above the bottom, a condition that does not differ materially from the first theory. These instances are cited merely to show the need of further investigation along the lines of determining stresses in concrete work.

There is a chapter on hollow concrete blocks that deals with the materials, methods of manufacture, the strength and cost. The final chapter contains tables and diagrams that will add to the general usefulness of the book for office work.

The Proper Distribution of Expense Burden. By A. Hamilton Church. New York, *The Engineering Magazine;* 116 pages, 5 in. x 7½ in. Cloth. Price, $1.00.

The chapters of this book are a series of articles reprinted from *The Engineering Magazine* on the subject of the proper distribution of the expenses of an establishment on the items of manufactured product. The fundamental principle upon which the method advocated by the author rests is that the averaging of the general expenses of the shop and the office and distributing them, *pro rata*, over the product on a percentage basis, is wrong, whether that percentage is based upon the wage or time cost of the article in question. He argues that the error lies in the fact that, in the case of the wage basis, it is quite possible that a low rate of wage may be paid for the running of a large and expensive machine so that the percentage borne would be out of all proportion to the investment. But, if the time rate be the basis, it may happen that on the same article a good and a poor workman may be consecutively employed, with the result that in one case the percentage would be high and in the other low for the same product.

The plan proposed is to consider a factory as composed of a number of small shops, and that each one of these is doing an independent business, and as such is obliged to pay interest on investment in machinery and rental for space occupied and for light, heat and power furnished. It is evident that if such a condition existed and each machine were to be owned and operated by a separate person, the fixed charges would go on without variation, whether the machine were to be idle or not. Why, then, should not the same condition be assumed in the case of the factory? Idle time represents a loss, and it is only the loss resulting from idleness that is to be distributed over all of the items of manufacture in the form of a supplementary charge, and this is done pro rata in proportion to the other charges of the article.

In the allocation of these charges a very sharp distinction is drawn between a job and work order, in that the works order may consist, and usually does consist, of a number of jobs. The job is defined "as the amount of time spent by any particular workman on any particular piece or similar set of pieces." And it is in connection with this idea of the job that the factory is considered as divided into a number of small shops that are doing an independent business, so far as costs are concerned, in everything except the individual bearing of losses accruing from idleness.

In making the first charges the rental of the building is divided among the several machines on the basis of the space occupied, and the cost of light and heat is likewise divided among them on the same basis, while the power charge is on the basis of the amount consumed, to which is added an interest and depreciation charge dependent on the value of the machine. Shop supervision is apportioned in accordance with the amount of attention required by the different machines, and general office and selling expenses are analyzed in the same way and allotted in accordance with the demands of the different products for the services of the advertising, correspondence and general management departments.

The system is naturally complex and its introduction could not be accomplished in a day; but it is evident that the information gained by the application of such a system would, after a time, more than repay for all of the expense and trouble involved in its application, and that when once in full swing the details would require but comparatively little time, if the evidence of those who have worked along similar lines is of any value. So the book may be regarded as a valuable contribution to the literature of cost accounts.

Geschwindigkeitsmesser fur Motorfahrzeuge und Locomotiven. Fr. Plug, Regierungsbaumeister. Mit 312 Fig. im Text; 285 pp. Berlin, 1908. Julius Springer. Price, $2.85.

This book on speedometers was compiled at the instance of the "Mitteleuropäische Motorwagen-Verein" to serve as a reference for the present status of speed measures for motor-vehicles. The author has found it desirable to extend the scope so as to include speedometers for locomotives.

The arrangement of the book is systematic but it lacks an index, so that in looking for a particular item the reader mu t be content with the table of contents. The first chapters are concerned with the general requirements of speed indicators for automobile, for locomotive and for street railway service, a description of the different types of instruments and of the mechanical laws on which they depend. The component parts of the apparatus are treated separately, thus affording an opportunity for their critical discussion. Then follows a detailed description, accompanied by excellent illustrations, of the most noteworthy speedometers in use in Europe. A list of the prominent patents taken out in Germany (in each case the short description is illustrated by a diagram) completes the book.

The measurement of the speed of a stationary engine is a simple matter—it consists in counting the number of revolutions. Using the number of revolutions of a wheel whose diameter is known is the basal principle employed in speedometers to determine the length of the path described by the vehicle. The record of speed should be made to depend wherever it is feasible, not on the revolutions of a driving wheel but on those of a driven wheel. The former is at times subject to slipping which would be recorded as distance traveled although it is only circular motion that has in any way moved the vehicle, and to the extent that it takes place, the speed record would be too high. Even when properly connected there are inherent sources of inaccuracy in the wheels themselves, so that under favorable conditions a speedometer can only furnish approximately correct records or indications. In case of automobiles the diameter of the wheels will vary with the degree of inflation and the load, in vehicles with iron tires the wear of the tires will gradually diminish the diameter of the wheels. The author gives the limit of allowable error in a good instrument as plus or minus 4 per cent.

At different times prize competitions have been invited by various corporations and associations in Europe for speedometers to meet certain specified requirements. The author gives the specifications to be fulfilled in the competitions invited by the "Grosse Berliner Strassenbahn-Gesellschaft in 1901, by the Mitteleuropäische Motorwagen-Verein in 1905 and by the French Automobile Club in 1906. These specifications give a good conception of what should be required of a good speedometer.

E. F. E.

Letters to the Editor.

THE LAW AND THE RATE.

Tucson, Ariz., Dec. 1, 1908.

To the Editor of the Railroad Age Gazette:

The practice of making through rates by combinations of locals over junction points which has been followed by the railways of the United States since interline waybilling was first established is recognized by the Interstate Commerce Commission in Rule 5 of Tariff Circular 15A. The Commission adds that the practice is universal, and that rates thus made have the same binding effect as through published joint rates. It furthermore views with great favor the publication of proportional rates to and from important junction points and gateways, thus facilitating the more speedy adjustment of through rates to meet changing commercial and traffic conditions. While it is true that many of the utterances of the Commission have no more binding effect on the roads, from a legal point of view, than the utterances of any private individual until passed upon by the court of last resort, it behooves us to ask, "Is not this ruling essentially sound?"

In response to a request from the Accounting Department, one of the most eminent railway lawyers of the United States has recently expressed the opinion that through billing should be discontinued unless there is a through published rate. His opinion is based on the argument that the delivering line, in collecting charges on a through waybill, where the rate is based on a combination of locals, is making itself a party to tariffs of other lines in which it has never concurred and is assuming legal responsibility for the correctness of the rates of other lines, and that the Commission has never intended that one line shall thus assume responsibility for another line, or that it shall hold itself legally bound to collect any undercharges that may arise by reason of the errors of other lines and their agents. While the opinion does not explicitly so state, the only logical inference that can be made from it is that the delivering line not only cannot thus be held responsible, but that it cannot legally undertake to make collections in this way for account of other lines, even though it should be willing to do so.

As an abstract legal theory this opinion seems well-founded. In practical every-day railroading is it as sound as the Commission's recognition of the precedent of past years? Are we not in danger of losing ourselves in a maze of abstract legal theory? In our endeavors to adjust ourselves to the new regime, are we not in danger of going to the extreme of considering the traffic of the country as created to conform to some legal theory instead of squarely facing the situation and making the law an aid in the development of commerce? Will the Accounting Department hue to the lines of this legal opinion?

The few that do well find themselves hugging the phantom of self-righteousness while their more practical competitors are handling the business.

As a concrete example, let us take the case of a small shipment moving from some remote New England point to destination on a small line in Nevada. The through rate is made by the combination of a local rate to some seaboard terminal, plus a through rate from that point to the junction of the little Nevada line, plus the local rate of the delivering line from that junction to destination. We will assume that the New England line has made an error in its rate to the seaboard terminal. After the shipment has been delivered and the charges paid as billed the error is discovered and the New England line issues correction. When the undercharge reaches the delivering line, if the theory of the Accounting Department is acted on, they can only say to the New England line: "We are not a party to your tariff and we cannot under the law undertake the collection of this undercharge for you." If the originating line complies with the law as interpreted by the Commission, it must collect the undercharge or lay itself liable to suffer the penalties prescribed by the law for deviating from published tariffs. It must send its own representative to collect the undercharge or maintain a representative for that purpose at the destination of the shipment, or it must file power of attorney with the delivering line to collect such undercharges as may arise.

Let us see whither we are tending. It means one of three things: Further consolidation of the railways of the country; an enormous increase of the publication of through rates over anything that is known now, or the demand on the part of a very strong minority for government ownership. The normal consolidation of existing lines is not likely to be greatly accelerated. We may lay aside for the present any discussion of government ownership, which could not fail to be, under our present form of government, the worst calamity that could befall the transportation industry and commerce of our country. It remains, therefore, to consider the extension of the publication of through rates.

The publication of any single rate by any individual line is a matter of not more than forty days at the outside. If another line is a party to it, the time is proportionately increased. When 75 or 100 lines are parties to it, the time consumed in getting any rate published and into effect can only be estimated from concrete instances of tariffs that are now going into effect which have been in course of compilation for the past two years. Governmental supervision and control of our transportation industry is a good thing up to a certain point, but it will break down under its own weight and defeat its own purposes beyond that point. Just as surely as we establish a system that is not sufficiently flexible to meet the changing commercial conditions of the country, just that surely will we stifle the commerce of the country. The only alternative will be the promulgation and protection of rates without compliance with all the provisions of the law. The injection of too much abstract legal theory into the arteries of our commerce can only mean the stifling of that commerce or the death of the law. The law should be made for our commerce and not our commerce for the law. Whither are we tending?

G. C. WHITE.

INTER-ROAD TICKET REPORTS.

Denver, Colo., December 28, 1908.

To the Editor of the Railroad Age Gazette:

It is generally conceded that the present system of a monthly exchange of inter-road ticket reports is unsatisfactory. This is due chiefly to the great bulk of such reports. The desired improvement could therefore be best obtained by dividing them into four "weekly" reports. The first three could be made to cover seven days each. The final report of the month to cover the balance of the month's tickets and the whole month's baggage, exchange and correction reports. As it obviously would be impracticable to make a weekly settlement the final report of each month could be accompanied by a recapitulation showing the amount of the four weekly reports to be used in making a monthly settlement of revenue.

Agents' monthly reports of interline tickets issued have been replaced in many instances by reports covering shorter periods, much to the advantage of both agents and accounting departments. In making up these smaller reports agents are able to send reports in promptly at the close of each period. It is also essential that tickets be reported in the period for which they are stamped.

The weekly system could well be carried to the inter-road reports with little or no increase in the cost of the cheaper labor and a material saving in that which is more expensive. No small part of the work on interline accounts results from the unwieldy reports, necessarily rushed through with great regard for time and small regard for accuracy. The consequent result is an expensive mass of errors. Handling the smaller reports should reduce to the minimum the errors in

inter-road reports with the result of a decided saving of wasted time.

Nearly all of the expense incurred in handling passengers on foreign tickets is carried on under credit extended from 30 to 90 days. With the monthly report plan now in use this is done without definite knowledge as to the date and amount of payment to be made. Reducing the size of the reports as outlined would bring settlement at least two weeks nearer to the time that value is given. Estimates of earnings would be more accurate as the weekly reports would give prompt information not obtained under the present system. The time gained under the above suggested arrangement would obviously be of great value in the preparation of monthly and annual reports.

Companies desiring not to change the method of auditing the coupons could continue their present methods and at the same time have the benefit of the prompt information contained in the weekly reports and the earlier settlement of revenue balances. Many beneficial results not mentioned would accrue.

HUGH C. EDMISTON.

MACHINE FOR TESTING FLY WHEELS.

Lafayette, Ind., November 30, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

I wish to acknowledge receipt of copy of your issue of November 27, containing my paper on machine for testing fly wheels. I notice in this same issue some editorial comment and criticism on the paper. I should like to offer further comments which may throw light on some points that are apparently not well understood.

In the first place, as stated in the paper, the mathematical solution of the problem was made by Professor Hancock and not by myself. I have taken the treatment directly from his paper with some minor changes. I only did this as an introduction to the real subject of the paper, which was a description of the proposed testing machine.

As regards the anvil support for the rail, I would say that there are two different problems to be solved in a test of this character:

First, to determine the relative energy of impact of different lengths of flat spot with different speeds and weights so as to arrive at some rational formula. This, I think, would be done best by the indentation of the metal on an anvil, as shown, since all effects due to the elasticity of the rail and ballast would be eliminated.

Another problem is to determine the effect upon the rail, and, as is mentioned in the last part of the paper alluded to, this can readily be accomplished with the same apparatus. The revolving rail may be guided by supports some distance apart to imitate the ties, or, what is perhaps better, for the soft metal underneath may be substituted another rail resting on ties and ballast.

For determining the wear and deterioration of the rail under continued blows, the apparatus devised by the Pennsylvania Steel Company is probably the most satisfactory apparatus yet built.

It seems to me that it is desirble to know by experiment just what is the energy of impact of flat spots of different shapes and lengths with different weights and speeds, the energy of elliptic wheels and of defective counterbalance. While these may be determined approximately by mathematical means, there are too many elements entering into the problem to allow of such solutions being conclusive.

Allusion is also made in your editorial to the standard drop test for rails. It was not intended that this should be used as a standard of comparison for experiments made on the testing machine. It was only introduced in the paper to show approximately the relative magnitude of the energy of impact of a flat spot compared with that used in the drop test. To most people, so many thousand foot-pounds does not mean much unless it is compared with some other quantity of energy more or less familiar.

C. H. BENJAMIN,
Dean of the Schools of Engineering, Purdue University.

A CAR RECORD CRITICISM.

Bellwood, Pa., Dec. 7, 1908.

TO THE EDITOR OF THE RAILROAD AGE GAZETTE:

One of the weak points in present day railroading methods, especially on larger systems, is in the car record department. This department, while in reality one of the most important in view of the repeated inability of railways to supply sufficient equipment to take care of traffic offered, is seemingly not given the attention which it deserves. It is the consensus of those in position to know that this inability to handle traffic offered is due, not so much to their lack of sufficient equipment, as to their inability to get the equipment they have loaded, moved and released promptly.

If the railways were running a storage warehouse business, then the present method of car service association supervision to look after terminal delays might be all right; but this is not the case, and railways are depending for revenue upon the car only when it is moving, either under load or toward lading. Generally speaking, the less it stands still, the more revenue it will earn.

Most of the supervision in operating departments is now being directed toward looking after the car while moving, and it gets comparatively little supervision while standing still. From this it appears that the object is to get the car standing still just as quickly and safely as possible. If such supervision is necessary, and no doubt it is, would it not be well to have a department with the object of keeping the car moving, and have it work against the department which is trying to get it to some place where it will stand still?

At present, the department nearest in touch with car performance is the car record office. This office cannot tell what the cars are doing now but only what they did do. Knowing that the delays were bad last month, it is almost powerless to make any better showing this month. What is wanted is a system which can make two records grow where only one grew before, or make each record mean more mileage, which is the same thing in the end.

So much for the disease; now for the medicine. Could not the historical feature of car records in the general office be sacrificed a trifle, and a little more of the "hurry up" feature be substituted? The management entrusts the maintenance and operation of a division to a division superintendent; why not entrust the car to him, so far as record is concerned, and simply ask that he use it, keep a record of what it does, and return it promptly; then make it the business of the general car record office to see that he does this?

To go a little more into detail, my plan is this:

Let the general office records be kept in such a manner that only movements between divisions be shown, and let these records be worked from division interchange reports made by yard masters at interchange points and forwarded, one copy to the general car record office, one copy to the division car record office delivering car and one copy to the car record office of the division to which the car is delivered. These reports to be forwarded every six hours, or as often as train service will permit. Then let the general office keep a record of movements to and from foreign roads, as is now done, of per diem accounts, etc. In short, treat each division as though it were a siding or yard.

The division car record office would keep the receipt and delivery of car to connecting divisions or roads, siding movements while on the division worked from conductor's car reports and mileage made, when necessary. This division

record to be kept in such a manner that at all times the conditions at every siding on the division shall be shown clearly. To carry out this latter suggestion, I recommend that wherever practicable, especially on feeding divisions, the following plan be adopted.

A card 2 in. x 4 in. for each car received on the division colored as follows:

Home cars	White
Foreign cars	Green
Individual cars	Blue

Small red stickers to paste on bottom of cards for penalty and hurry cars.

A case containing a pigeonhole for each siding on the division.

A filing case for cards of cars which have left the division but which are still active for record purposes.

The card to be moved through the filing case as the car is moved over the division, the initial and number to be placed at top of card followed by a trace of its movements. When the car has left the division the card is taken out of the siding case, and any information necessary is taken off, such as mileage made on certain classes of cars for monthly report to general car record office. After this has been done card is filed in filing case, classified as to initials, terminal numbers, etc.

You will note that the object of this system, while the car is on the division, is to keep it moving, and the open pigeonholes, the color of the cards and the red stickers are all means to that end. The record of what the car has done, while complete, is given secondary place. After the car has left the division and the card becomes active as a record, then only it is filed, with the prime object of easy reference, or from a record standpoint.

It may be urged that with present conditions a change of this kind is not necessary and this article is ill timed, but the idea is more or less radical, and could be tried best when business is light, since certain changes and adjustments would have to be made to meet local conditions, and these changes would take time.

ROY M. BAKER.

FLAT SPOTS ON CAR WHEELS.

New York, January 5, 1909.

To the Editor of the Railroad Age Gazette:

In your issue of November 27 there was a communication regarding the dynamic effect of a flat spot on a car wheel on the rail, in which the blow was measured by the mathematical analysis of the motion of the flat spot about the first edge of the same to come into contact with the rail. This was followed on Dec. 4 by another mathematical analysis showing that the drop of the leaving edge of the flat spot depended upon gravity, and that a sufficient interval of time did not elapse for this to act and bring the flat spot down on the rail, when the speed was much above 4½ miles per hour.

Now, every practical railway man knows that the flat spot does deliver a very substantial blow at speeds above five miles an hour if the evidence of the sense of hearing and an occasional bent rail is of any value. So it seems that there must be something wrong, not necessarily with the mathematics but with the premises on which the calculations are based.

A suggestion is offered to the effect that both writers of the articles referred to based their computations on gravity, as if this were the only thing to be taken into consideration, but there are others.

For example, the weight of the car is resting on the axle box through the intervention of a spring, and this spring is, therefore, under considerable compression and ready to expand with all the strength of its elasticity the moment it gets a chance. The axle is being drawn by its housing and the truck pedestal, in which there is considerable lost motion, and so is crowding back against the fixed parts of the truck, and there is always a possibility of its being thrown forward to the limit of the lost motion by any force tending to drive it to the front. So when the wheel starts to roll over the flat spot there is the quick action spring tending to push it down and forward. This spring has a compression due to the load above, which may be 18,000 or 19,000 lbs. Taking the lower figure and considering the wheel and half the axle to weigh 1,075 lbs., the rate of acceleration during the fall of the wheel will be about 17.7 times as fast as when gravity alone is at work. This would immediately raise the speed at which the train can be running, and the flat spot strike its full blow from 4.55 to something more than 79.5 miles an hour, modified by the decreasing tension of the spring as the wheel drops away from it, by which the rate of acceleration is correspondingly decreased. The problem is further complicated by the size of the spring, as the fall in spring pressure will be the more rapid as the stiffness of the spring and its consequent compression is increased, and the severity of the blow will be increased according to the downward velocity of the wheel at the moment of the impact of the flat place. Further complications are added, in practice, by the motion of the load at the moment. If the car body is rising in its vibrations the blow will be less than if it is falling.

It appears, then, that this spring action accounts for the fact that the severity of the blow apparently increases with the speed, because the spring has a chance to produce a rapid downward acceleration, and may account for the destructive effects produced both on track and rolling stock, while the complexity of the forces involved renders a mathematical analysis and solution of the problem no easy task and one that would not be conclusive when it were finished, simply because there would be no certainty that all of the factors in the case had been taken into consideration and given due importance.

GEO. L. FOWLER.

Contributed Papers.

TRAIN ACCIDENTS IN NOVEMBER.[1]

Following is a list of the most notable train accidents that occurred on the railways of the United States in the month of November, 1908. The monthly records are intended to include usually only those accidents which result in fatal injury to a passenger or an employee or which are of special interest to operating officers. They are based on accounts published in local daily newspapers, except in the cases of accidents of such magnitude that it seems proper to write to the railway manager for details of for confirmation.

Train Accidents in the United States in November, 1908.

Collisions.

Date.	Road.	Place.	Kind of Accident.	Kind of Train.	No. persons reported Kil'd.	Inj'd.
5.	Pennsylvania	Allegheny.	xc.	Ft. & Ft.	1	2
*10.	Union Pacific	Borie.	xc.	Ft. & Ft.	10	3
10.	N.Y., N. H. & H.	Deep River.	xc.	Ft. & Ft.	4	10
*†11.	N. O. & N. E.	Little Woods.	rc.	P. & P.	8	20
13.	Wabash	Iles Junc.	bc.	Ft. & Ft.	3	1
†14.	At. Coast Line.	Cambon.	bc.	P. & P.	2	1
21.	Ann Arbor	Lakeland.	bc.	Ft. & Ft.	3	1
21.	Illinois Cent.	Berwyn.	xc.	Ft. & Ft.	1	2
22.	At. Coast Line.	Nansemond.	bc.	Ft. & Ft.	1	1
*†28.	N.Y., N.H. & H.	Boston.	rc.	P. & P.	5	50
28.	Seabrd A. Line.	Silver Springs.	bc.	Ft. & Ft.	5	2

[1] Abbreviations and marks used in Accident List: rc, Rear collision——bc, Butting collision——xc, other collisions——b, Broken——d, Defective——unf, Unforeseen obstruction——unx, unexplained——derail, Open derailing switch——ms, Misplaced switch——acc. obst., Accidental obstruction——malice, Malicious obstruction of track, etc.——boiler, Explosion of boiler of locomotive on road——fire, Cars burned while running——P., or Pass., passenger train——F., or Ft., freight train (includes empty engines, work trains, etc.)——Asterisk, Wreck wholly or partly destroyed by fire——Dagger, One or more passengers killed.

Derailments.

Date.	Road.	Place.	Cause of derlmt.	Kind of train.	No. persons reported Kil'd.	Inj'd.
11.	Pennsylvania	Pittsburgh.	unx.	Pass.	1	1
17.	Balt. & Ohio	Cowan.	d. track.	Pass.	..	25
18.	St. L., B. & M.	Refugio.	ms.	Pass.	1	1
20.	Southern	Leighton.	unx.	Ft.	2	0
22.	St. L., B. & M.	Sinton.	d. wheel.	Pass.	0	13
30.	Balt. & Ohio	Valencia.	acc. obst.	Pass.	1	5

The most notable accidents in the foregoing list are the collisions at Borie, Wy.; Deep River, Conn.; Little Woods, La.; South Boston, Mass., and Silver Springs, Fla.

The collision at Borie was the result of a heavy freight train getting beyond control on a steep grade. This train crashed into a work train, making a very bad wreck, which took fire and was mostly burned up. Ten men were killed; five trainmen and five Japanese laborers. Three employees were injured. The cause of this accident appears to have been mismanagement of the air brakes. A report of it was published in our issue of December 18, page 1,600. This incident is the first one of this character to happen on this grade (between Laramie and Cheyenne) in 30 years, though 10,000 trains are moved over it annually. The grades are from 43 ft. to 85 ft. to the mile. On the steepest parts frequent five-minute stops are required (with freight trains, descending) to allow the wheels to cool.

At Deep River a work-train backed into a freight train making a bad collision, which resulted in the death of four or more employees. The rear collision at Little Woods occurred in a fog. The foremost train, a passenger train of the New Orleans & North Eastern, was just leaving the station, where it had stopped, and was running about 10 miles an hour, when it was run into at the rear by a passenger train of the New Orleans Great Northern. Two passenger cars were demolished, and two other cars were damaged. The three rear cars were practically empty. Eight passengers were killed and about twenty passengers were injured. No train men were killed or seriously injured. The fault is attributed to the second train. At New Orleans, December 23, the grand jury, after inquiring into this collision, returned indictments for manslaughter against the general superintendent of the New Orleans Great Northern, the division superintendent of the New Orleans & Northeastern, the chief train despatcher of the New Orleans Great Northern, the conductor and engineman of the New Orleans and Northeastern, and the engineman of the New Orleans Great Northern. The indicted men were required to furnish bonds in the sum of $1,000 each.

The rear collision of passenger trains at South Boston on the 28th was only a mile from the starting point of the trains. The train, which left the terminal at 6.16, bound for Braintree, had stopped at the South Boston station. As it started to leave the station the 6.22 train, bound for Readville, came around a curve under Dover street bridge and crashed into the rear of the Braintree train. The locomotive ploughed into the rear car of the forward train, spreading the sides of the coach apart and driving seats and passengers and wreckage half way the length of the car. The passengers were thrown into a confused mass at the forward end of the car. How many were in the car is not stated; but the number reported injured is 21. Two employees were killed. While the accident was caused principally by the shifting of the Plymouth division train on to the Midland division, the exact cause of the accident could not be learned, the railroad officials refusing to make any statement. The yards are thoroughly equipped with the block signal system.

The accident at Silver Spring, Fla., was a butting collision of regular freight trains, causing the death of one engineman, two firemen and two brakemen. We have no details of the cause.

The collision at Cambon, Fla., was due to a meeting order being overlooked by the conductor and engineman of passenger train No. 39, which resulted in their train colliding with passenger train No. 10. Two mail clerks were killed. The collision at Lakeland, Mich., is reported to have been due to a misunderstanding which arose in connection with the substitution of one order for another. In the Nansemond collision an engineman misread the name of the station in a telegraphic order.

Of the 11 electric car accidents which were of enough consequence to receive prominent notice in the newspapers in the month of November two resulted in fatal injuries. Near Laporte, Ind., an electric car was struck by a passenger train, which was moving backward, and one passenger was killed and 12 injured. The other fatal accident was on the Sixth avenue elevated line in New York City. In this case two employees on a work train were killed and two injured in consequence of a derrick on a car having been left in a position where its boom projected too far upward and came in contact with the overhead structure of a station.

THE LOG OF THE NEW HAVEN ELECTRIFICATION.

DISCUSSION OF W. S. MURRAY'S PAPER.

The discussion on Mr. Murray's paper, which we published somewhat fully last week, was very complete and exceedingly interesting, not only from the standpoint of the engineers who have participated in the work of the New Haven installation, but also from those who are upon the outside and are more or less familiar with what has been done. In presenting this paper Mr. Murray said that this was not the place to indulge in hopes, or to bury facts, or to harbor prejudices, and that if we were to progress, we could not do it by guesswork, and hypothesis must give way to facts when we can possess ourselves of them. When a decision is to be made between one of two things, it is right that the burden of proof should be placed on one of them, and when the splendid record of achievement of the direct-current system for the past 20 years is taken into consideration, the burden of proof as to its value for adoption on such a system as the New Haven must necessarily rest upon any other system than that which had been so efficient. Therefore it remained for the single-phase work to show what it could do, and it must needs earn its spurs before it could be freed from this burden of proof. He thought that this had now been done, and that the burden of proof had been shifted to the shoulders of the direct-current system to show that it could render as efficient service on long-distance work as the single phase is now doing. This system had the advantage of offering a lower cost and equal reliability in service, and that was a point that no board of railway directors could afford to ignore.

Calvert Townley, Vice-President of the New Haven Lines: What the designing engineer wants to know and what the constructing and operating engineer wants to know, is, what troubles and difficulties is he likely to meet, and how they can be overcome. Such facts are given *in extenso* in Mr. Murray's paper. It is to be noted, however, that he has omitted the customary statement of conclusions usually drawn from the facts furnished in the paper, but these conclusions are none the less clearly indicated, though they may not be stated. Those which stand forth are that the system was put in without any previous similar installation to pattern after; that several of its fundamental features were either entirely new or had so new an application that their previous use was not much of a guide; that sundry defects developed as installation progressed, resulting in delays and interruptions to the service; that these defects have nearly all been remedied and certain other improvements have been made, and that now, five months after the complete substitution of electricity for steam, while some of the improvements have still to be completed, the system has been demonstrated to be successful and well adapted to the service for which it was designed. It is to be noted, also, as an interesting fact, that the electric service is at present less subject to delays and

interruptions than was the steam service which it replaced.

It may be well, possibly, to recall some of the pioneer features that were included in this installation. For example, it is the first installation of generate single-phase current in large units at a fairly high electro-motive force with a dead ground on one side of the generating system; it is the first installation to adopt—though not the first system to put into operation—the 11,000-volt a. c. trolley, with the rail return without any transformer, converter or other sub-station appliance whatever between the generator and the inductive itself; it is the first a. c. system to handle 800-ton trains at 60 miles an hour; it is the first to use an a. c. gearless 25.6-cycle motor, and also uses much the larger motors of this type. It is the first installation to adopt a locomotive unit designed to fit the great majority instead of the heavier train service, and to take advantage of the multiple unit feature of operating two or more locomotives together when heavier trains require it.

Now, the one radical thing that was done wrong in the New Haven electrification and which was really at the bottom of the major part of the difficulties that have been encountered, is that the electrification was not begun soon enough. It is undoubtedly true that had more time been allowed for attention to the minor details of equipment, and could work that had to be done under great pressure have taken its normal course, many of the minor troubles which can be traced to these facts would never have existed, and, furthermore, had there been time for a reasonable operating tryout, very many of the defects which have caused delays to service would have been detected and remedied during the trying-out period instead of in practical service.

Mr. Murray states that we are not proud of it. It does not seem that the system needs any apology whatever, and, except in respect to some power-house interruptions, the operation has had fewer checks than I anticipated it would have when it was first adopted.

I wish especially to indorse what Mr. Murray has said of the Westinghouse Company, who were the contractors. They are certainly entitled to high credit for the success of this project. Without them the work could not have been done. There was no one else who would undertake to construct a single-phase locomotive such as the service required. There was no one else who even then believed such a machine could be built. The contractors' tireless, resourceful, prompt and cheerful co-operation with the engineers throughout the entire progress of this installation has contributed the essential features of its successful development, and they are rightfully entitled to a full and frank acknowledgment thereof. Without the single-phase a. c. motor the whole plan would become impossible.

A study of the list of changes that were made in the locomotive originally furnished disclosed the interesting fact that while there were a number of electrical difficulties, a very large percentage of the changes made were mechanical. With the principal elements of the locomotive design, namely, the large, gearless, 25-cycle motors, there has been practically no trouble. Their performance as to torque, commutation and capacity has been most gratifying, and it has been demonstrated that the motors and transformers had a capacity for service in excess of that called for by their guarantees. The several changes made in the locomotive detail were not primarily to correct defects, but so to increase the capacity of the parts modified as to provide an excess of locomotive capacity. There is one point about the gearless motor that has caused no trouble and which has been a pronounced success, and that is the flexible drive by which it is wholly supported and through which it exerts its driving power to the wheels. Trackmen have frequently been appalled because electric locomotives are so much harder on track that steam locomotives of even greater weight, and it has now come to be a generally accepted conclusion that this is due to increased impact because the armature dead weight is supported without cushion rigidly on the axle. On the New Haven locomotives this weight is cushioned, and the results in track maintenance cannot fail to be of far-reaching consequence.

W. J. Wilgus. It is doubtful if an engineer is morally justified in seeking renown by a brilliant dash into untried ways at the expense of travelers who pay their fares, and to whom the delay involves not only inconvenience, but a direct monetary loss. There is no doubt that many would have been pleased if Mr. Murray could have seen his way clear to make public at this time detailed data substantiating his position regarding the cost of installation and operation. While his company has saved the cost of sub-station and battery, it would be interesting and instructive to know just how far that saving has been offset or exceeded by the increased annual costs incident to the use of overhead construction and alternating-current locomotives; the costs of rectifying errors; the expense of holding steam locomotives in readiness to haul disabled electric trains to and from the junction with the New York Central at Woodlawn; the loss of the many well-known benefits that accompanies the use of multiple unit cars in suburban territory, and the absence of those features which assure reliability in service so essential to trunk line operation. The value of reliability is illustrated by the never failing supply of power to New Haven trains on the New York Central tracks, while a loss of the same would have been most serious to the traffic of the three lines if interruptions had occurred like those within the experience north of the junction.

B. G. Lamme. It has been my part to give a great deal of personal attetntion in the design to the a. c. generators in the power-house and the main motors on the locomotive of the New Haven electrification system. It is usually supposed that the motor was by far the more difficult problem of the two, considering that it was the first large gearless single-phase motor constructed for commercial service. But from my point of view, and it has since been borne out in practice, the design of the motors was a comparatively simple problem alongside that of the generators. In the design of the motors there were two points which were generally looked upon as sources of weakness—the commutation and the use of preventive leads, or resistance leads, as some people call them, between the armature winding proper and the commutator. It was also assumed that there would be severe sparking in the commutators of these motors. The records of these motors show that the total of 164 have averaged slightly over 40,000 miles ever since being put into operation, the minimum miles for any one motor being approximately 28,000 miles; averages from 30,000 to 50,000 miles will cover the record of a great majority of these motors. Under these conditions, the commutators are all in first-class shape with a good polish and showing relatively little wear. All these motors have been dismantled for the causes mentioned in Mr. Murray's paper, but none of the commutators has been turned unless it had received some mechanical injury from causes external to itself.

As far as the commercial service is concerned, none has required any attention, and from the present rate of wear it appears that there is at least from 15 to 20 years' life in each of them. As there is relatively little sparking even when developing two or two and one-half times full load torque, there was no real reason why these commutators should not make such good records. Regarding motor injuries it will be found that the number of injuries to the armature represent only a small percentage of the total which have occurred, largely from external causes. In a few cases these damages have resulted from an actual burn-out of a section of the armature, necessitating partial rewinding. This work has given an opportunity to make a thorough examination and this has shown that there is no dangerous overheating from the heavy loads which have been carried, and also that the

preventive leads are showing no more evidence of heating than the main winding.

If any comparison could be drawn, I should say that the preventive leads were in the better condition of the two. In only two instances have they broken down, either directly or indirectly. In short, the record for these leads is better than that for the main coils themselves, which is partly due to the fact that they are below the latter, and thus better protected mechanically, and their record may be considered as simply marvelous. If the rest of the system had shown anything like as good a record there would have been no occasion for the greater part of Mr. Murray's paper to-night.

In the generator no defect has developed which was not foreseen and provided for, based on the limited data at hand. The most pronounced difficulty in the first machine was with the heat in the rotor structure, not the winding, due to the pulsating reaction of the armature winding when carrying a heavy load in single-phase current. This was known previously, but in smaller machines had not developed destructive tendencies.

In the first rotor the structure was laminated as completely as mechanical conditions would permit, but it is almost impossible to laminate everything, due to the fact that the mechanical requirements call for rigidity in some of the structural features. On testing this first machine it was found that there was some local heating, with a heavy load sufficient to create hot spots in the core, and these in turn damaged the insulation on the coils from the outside in a comparatively short time. It was shortly discovered in our efforts to eliminate these hot spots, that we were not applying the correct remedy, and it was decided to attempt to eliminate all pulsating reactions from the armature by putting a short-circuit winding on the rotor of such value that a very large current could flow in it with very little loss. The rotor had not been designed originally for this purpose, and it was therefore difficult to adopt the most suitable proportion in this winding, but what we did put on immediately showed in practice that we had applied a practical remedy for the trouble. Meanwhile, we were bringing through new motors designed for the application of heavy cage windings, and upon the installation of these the field or rotor trouble all disappeared, and on the fourth machine a solid steel core was used in the surface, of which the copper cage is embedded, and with it all pulsating armature reactions have been eliminated, so that there was no further occasion for laminating the fill.

This work on the generators was done before full electric service was established. With one generator running there was but little or no disturbance due to short circuits, and it only appeared when more generators were put into service. It then soon became evident that there was some serious condition existing in the system, as indicated by the extremely violent shock to everything in case of short circuit. This was particularly noticeable in the switching system. We had calculated that these machines would give possibly six or seven times full load current on the first rush, but the indications were that this was being greatly exceeded, so that a series of oscillograph tests were made to determine the current rush, and it was found that under certain conditions each machine could give at moment of short circuit 5,000 amperes on one phase, the full normal load current being 340.

With three machines in parallel this would therefore mean that approximately 15,000 amperes could be delivered momentarily. This enormous rush of current was sufficient to explain many of the difficulties. While this work was being done the generators in the power-house had been suffering from the tremendous shocks which accompanied short circuit on the line, and our experience with the windings on these machines indicated that they were being subjected to enormous forces in the end windings. As the machines could give about fifteen times full load current momentarily, the force acting on these end windings would be 225 times normal, so that it was a serious problem to devise a type of bracing on the end windings sufficient to withstand such a force. Further, it is probable that as many of these shocks were experienced in a day as would ordinarily be experienced in a year on an ordinary high-voltage power-house generator. Probably the most complete system of bracing ever applied was put on these generators, yet in spite of this there was evidence of movement at times, so that it was evident that some laminating method would have to be applied. This was done by an insulated shock coil on the trolley side of each machine. When these were installed the results on the power-house were evident. The shocks were very greatly reduced, so that no further trouble is feared from this source.

An interesting point in connection with the use of the cage windings on these machines is that the apparent regulation of the system has been improved. This was anticipated, but the actual result was more pronounced than was expected.

It must be borne in mind that in one way this New Haven installation was more difficult than anything undertaken heretofore, and that is in the use of a 11,000-volt generator, with one terminal connected directly to the ground. Taking this condition into account, together with the enormous current rushes with consequent shock on the winding, and the single-phase operation of units of such large capacity, it may reasonably be claimed that this is the most difficult case of a. c. installation ever undertaken.

L. B. Stillwell. In the case of the New Haven equipment it is apparent that investigations and tests preliminary to commercial operation were not carried out with that degree of care and thoroughness which a work of this importance would justify and which our German fellow-workers consider essential. Mr. Murray is just emerging from a long and most trying contest with difficulties upon a conspicuous stage. The installation for which he is thus largely responsible did not, during several months of initial operation, attain that degree of reliability which the traveling public has a right to expect, and naturally has been subjected to severe criticism.

The engineering world is fortunate in the fact that the New York Central railroad and the New Haven company have not adopted the same electric system. Such an opportunity to compare the possibilities and limitations of the direct-current system and the single-phase alternating current system is unprecedented, and, except in America, would be impossible. Whatever we may think of the waste of investing millions to learn from experience the answers to questions which by German methods, for example, might be answered at much less cost, we are in no position to complain of the lack of opportunity to subject our ideas to the test of practice. Unquestionably, each and every problem of electrification should be estimated primarily with reference to local conditions and requirements, and in any given case it is conceivable that each local condition and requirement may lead properly to the adoption of a system other than that which would be chosen to solve the main general problem of electrifying not only a terminal and limited suburban road, but a railway division or trunk line. This frank expression then of the result attained should assist in the proper evolution of that system which is fittest, and therefore destined to survive.

When R. J. Sprague installed the multiple unit system of train operation in Chicago, a most important advance in the art of railroading was made. The applicability of this system to trains requiring tractive efforts exceeding 60,000 lbs. was demonstrated first in the New York subway and the equipment of the New York Central has contributed to our demonstrated utilities an excellent third-rail construction, and has afforded the fact that within the limits of this zone electricity can do the work better than steam. The New Haven installation, with its substitution of 11,000 for 600 volts opens the door to possibilities of electrification of railways far beyond the reach of 600-volt direct-current. The weak point in the installation of the New Haven system was the failure to study,

in detail, every element of equipment involved and to subject every link essential to reliable operation to careful analysis and test before installation. This was not done, and it may be attributed in part to the fact that it is characteristic of American managers to consider matters for a long time before reaching any decision, and then, when that decision has been reached, to urge execution more rapidly than conditions will warrant, without allowing sufficient time for investigation.

The fact, then, that the New Haven road has experienced an unusual number of delays due to power-house troubles is due to errors in the design of the generators, and in the high-potential circuit breakers which, it would seem, could have been avoided by the exercises of that degree of care and forethought which the importance of the work warranted. So far as four months' operation may be taken as a safe guide, there is nothing in the record which is discouraging as real performance of the electrical equipment of the locomotives. If we accept the delays due to circuit-breaker failures, the record is a good one.

It would be of great value if Mr. Murray would supply, for purposes of comparison, the record of train delays in steam operation during the corresponding months of the preceding year, and it is to be hoped that the engineers of the New York Central will follow the example that has been set and make public a log of their own electrification, showing results obtained as compared with preceding steam practice, thus affording an opportunity for accurate comparison of the result obtained by two contrasted electric systems in the operation of these important properties. An incidental problem that has apparently been solved in a satisfactory manner is the protection of existing telegraph and telephone systems from the effects of induction due to power currents. It is too early yet to speak of the reliability and safety of the high-potential overhead trolley and feeders, when subjected to the conditions imposed by snow and sleet, and it is to be hoped that a further contribution to the log will be made showing what this effect has been during the coming winter months. I observed recently in Hamburg that the single-phase system in use in that city employs the same method of supporting the trolley wire that has been adopted on the New Haven line, by which the trolley wire is converted into a catenary construction with a secondary suspension cable.

A. H. Armstrong. It is my understanding that the a. c. single-phase system was adopted in the New Haven installation in order to afford opportunity to demonstrate the suitability of that system to the officers for the electrification of the road. It is my further understanding that preference was given the system for the reason that it was considered to be a cheaper system as to first cost than either the 600 or 1,200 volt d. c. systems, proposals upon which were also received. It is instructive to know how nearly the early claims advanced for the a. c. system have been fulfilled in the completed installation. In 1905 Westinghouse published an estimate of $18,436 per mile as sufficient to cover the cost of contact line on a four-track road between Woodlawn and Stamford. Presumably this figure covers the same labor and material estimated to cost nearly $55,000 by Mr. Wilgus. In view of the wide discrepancy between the trolley construction as proposed and as completed, it would be instructive to know which of the two figures is nearer the actual construction cost.

The locomotive changes have been extensive, and have been stated most frankly, and it is claimed that the machines have more than fulfilled their guarantee of a capacity to haul 200 tons trailing. A log of the run giving the time required to haul 200 tons trailing with 45 second stops, averaging 0.451 per mile, would have been most interesting. If the present locomotives fulfill the guarantees as to performance of a 26 m. p. h. schedule with 15 per cent. margin in time, it may account for the increase in locomotive weight from 68 tons total, as proposed, to 102 tons as now in operation. The fact that these locomotives have increased in weight is due either to the fact that the condition were misunderstood when the locomotive was first installed or else through development of the alternating current motor it has become necessary to increase the weight over the original estimate. It is reasonable to suppose that the cost of these locomotive units has increased at least in a like ratio, although it is my experience that it costs fully 25 per cent. more to construct an a. c. single-phase locomotive than one of equal weight equipped with d. c. motors. While preference may originally have been given the a. c. motors for this installation with the limited knowledge of its operation, it is difficult to find the present enthusiasm for the system that applies in many ways to the New Haven conditions. In this connection I will state that the weight of the locomotive as now installed approaches fairly nearly the estimated weight of the locomotive, which the company with which I am connected said would be required to perform the service. In time perhaps the two weights will coincide. The interruptions to traffic that have been outlined can only be tolerated if a far-reaching object is to be attained. In view of the fact that the a. c. trolley construction as installed on the New Haven apparently costs 80 per cent. more than a 600-volt third rail and the a. c. locomotive costs at least double for the same service performed, it is instructive to compare the operating results secured with the two systems:

Comparative data a. c. and d. c. locomotives.

	Central 600 volt d.c.	New Haven 11,000 volt a.c.—600 d.c.
Weight total	94.5 tons	102 tons
Weight on driver	68.5 "	77 "
Number of motors	4	4
Total h.-p., 1 hr. rating	2,200	1,000
Guaranteed trailing load	400 tons	200 tons

With the same total weight a single Central locomotive unit has a capacity equal to two of the New Haven. Attention has been called to the fact that the average weight of trains on the New Haven road is approximately 212 tons. A list including the majority of trains on the New York Central which completed the guarantee of the trailing load of 400 tons shows that their weights run from slightly over 400 tons to almost 700 tons, and each of these trains was handled by a New York Central unit weighing less than 100 tons, and that each of these would have required at least two of the New Haven locomotives. Inasmuch as these two locomotives weigh approximately the same, I am willing, for the sake of argument, to admit that the cost of each locomotive is the same, we then have the spectacle of about 60 trains a day hauling, on the New York Central, for a certain sum of money, which, if the system had adopted single-phase would have required double the locomotive cost for the same service. And in a list that has been drawn up it is to be noted that every train on the New York Central hauled by a single-unit would have required two on the New Haven. The reliability of the d. c. and a. c. system is clearly illustrated in the following table of total delays for the months of July to October inclusive. The a. c. figures are taken from Mr. Murray's paper and the d. c. figures form the simple operation.

Train Minute Delays, Central and New Haven. Four Months—July-October, 1908.

	New York Central.	New Haven.
July	41	2,281
August	53	1,611
September	18	893
October	48	910
Total	160 min.	5,695 min.

The New Haven figures make no note of delays of over 300 minutes. The Central figures include delays due to locomotives or operators only. During these four months there were no delays due to generating, transmission, substitution or third rail and feeder distributing systems, in spite of the alleged complication of such a system.

In using Mr. Murray's figures where every statement is made over "300 train minute delays" I have taken 300 train minutes only. The figures given on the New Haven include all delays due to electrical apparatus. On the New York

Central they include only operator troubles and locomotive troubles. The reason for this is that during the four months in question there were no delays due to the generating system, the translation system, step down transformers, rotary converters, third-rail, third-rail feeders, and all the complex paraphernalia which applies to the three-phase direct current system, where the generating station does not feed direct to the locomotive.

I am an enthusiastic believer in the future of the a. c. locomotive, but in view of the fact that the generating station does not cost less, that the transmission by overhead trolley construction costs 50 per cent. more than the New York Central third rail, that the locomotives cost double those used on the Central, it is hard to find a reason for the extravagant enthusiasm concerning the a. c. system as installed. I believe there is a place for the a. c. system, a large field to be covered by it, but I do not believe that the facts as presented have justified the selection of the alternating current system on the New Haven road.

E. B. Katte. There are two cases mentioned in Mr. Murray's paper when no power was available on the third rail—one on July 8. On that day, unfortunately, some signal-erecting man dropped a pole across the two tracks and broke down the third rail, and there was some delay in getting the third rail built up again. On the 10th there was another delay of 13 minutes on the New Haven train, due to no power on the third rail. The third rail was broken down because of a freight wreck, and the delay was in building up the rail. I think I can say at no time has there been a lack of direct-current to apply to the third rail when the third rail was there, and further, that when the third rail has been knocked down, due to a wreck, it has been my experience in most cases the third rail has been erected and ready for service as soon as the wreck had been cleared and the running rails were ready for service again.

C. L. De Muralt. It does not seem to me that for the sake of the single advantage of using high pressure in the contact line it is worth while to undergo all the serious disadvantages which single-phase involves; in other words, is it justifiable to use single-phase alternating currents in heavy trunk line work, under which the New Haven installation must be classified?

The most serious disadvantage of the single-phase locomotive, and the most important is its deficiency of power. The official figures are that the New York Central direct-current locomotive weighs 95 tons and produces a nominal output of 2,200 h.p.; the single-phase locomotive of the New Haven weighs 102 tons and produces a nominal output of 1,000 h.p.—23.2 h.p. per ton for the Central and 9.8 h.p. for the New Haven.

The overload capacities of the two locomotives show different figures, but they are in the same proportion.

Now, Mr. Murray stated that among the trains there are 27 per cent. of trains that require double-headers. Every one of these trains could be hauled by one single New York Central direct-current locomotive. If, therefore, direct-current had been chosen for the New Haven system there would be at least eight or ten locomotives saved out of forty-one; in other words, putting each one at a cost of $35,000, there would be a saving of, say, $300,000, simply in investment, which is now lost. Add to that the increase in current consumption and increase in the waste of useless and locomotive ten miles, and altogether I believe that many of you, even the greater percentage will agree with me that the New Haven has made a mistake in adopting the single-phase alternating current system in the present state of the art.

C. P. Steinmetz. It is especially gratifying to verify here from actual experience the statements which have been made by unbiased engineers from theoretical considerations, that heavy railway work can be handled by single-phase alternating current motors; obviously, not with the same high drawbar pull per ton of locomotive weight, possibly lower, at least for the present, not with the same reliability of service, though I believe this establishes the single-phase alternating current motor as one of the methods and one of the apparatus by which the future electrification of our country's railway systems will take place. I am especially gratified in that I may say that I am the oldest engineer on the floor who has designed railway motors as compensated single-phase direct current commutator motors, because the first of these motors was designed eighteen years ago, and looking over the design recently, I find that the relative proportions of armature commutating winding and field winding were almost entirely the same as embodied in our present motor, and even the frequency which was suggested was 30 cycles. I regret to say that none of these motors ever came into practical service, because this low frequency did not exist for years afterward.

While the drawbar pull per pound of motor weight of the alternating current may necessarily be lower than that of the direct current motor, because in the alternating current motor the magnetic field pulsates between zero and the maximum, and the same motor, therefore, when energized by direct current with the same magnetism, magnetic flux, would give 41 per cent. more commutation.

My conclusion, from the evidence and data now available, are the same as I expressed before, that those railway problems which cannot be handled by direct current must be solved by the alternating current motor, and, as we know now, can be solved by the alternating current single-phase motor, but where direct current as well as alternating current can be used, the higher weight efficiency, that is, the greater drawbar pull per pound of motor weight afforded by the direct current motor, necessarily makes this motor preferable from the electrical engineer's point of view. It is interesting, then, to note that in these railway problems which can be handled by alternating current motors as well as by direct current motors, the decision whether one or the other type of motor shall be used thereby has shifted from the electrical engineer to the railway engineer or the railway manager, and is determined by the economical question—whether higher weight efficiency, that is, higher drawbar pull per pound of motor weight, and at least, at present, a somewhat lower reliability of service, are sufficient compensation and should be sacrificed for the possibility at some time, when our electrification of railways extends further, of being able to extend the same system of operation over those parts of the road which cannot be operated by direct current, and such other roads where direct current cannot be used, or whether the higher weight efficiency of the direct current motor and the at present greater reliability of service, compensates for the possibility that at some future time, with the advance of the electrical industry and the extension of railway electrification, we may have to replace the locomotive equipment, or change locomotives at the end of the direct current zone and the beginning of the alternating current zone.

That, as I stated, now appears to me a question to be determined by economical reasons, by the railway manager and not by the electrical engineer, for whom, from my point of view and my experience, the question is decided that where direct current can be used it is preferable to alternating current, and alternating current can be used where direct current is not feasible any more.

Mail service from Western Europe to China by way of the Siberian Railway has been resumed. There is a mail three times a week; that leaving Berlin Monday and Friday goes over the Southern Manchuria Railway to Dalny (which the Japanese call Dairen), when a Japanese steamer line forwards it to Shanghai. The mail leaving Berlin Wednesday is taken to Vladivostok. By Dalny, if there is no delay on

the way, the time from Berlin to Shanghai is 16 days; by Vladivostok, 18 to 20 days. To Pekin and vicinity the carriage is all by rail. The Japanese have established a steamer line from Vladivostok to Tsuruga.

EXHIBITION CAR OF CHICAGO, MILWAUKEE & ST. PAUL.

The Chicago, Milwaukee & St. Paul is running a car through the middle western states for the purposes of advertising the resources of the country along its Pacific coast extension. The car is loaded with exhibits of the agricultural products of western South Dakota, Montana, Idaho and Washington. They include views of the new towns that have sprung up and also of the scenery along the line.

Parts of Iowa and Illinois have been traversed, and the car until recently was at the Corn Exposition at Omaha, where it attracted much attention. It will later be taken through other parts of Illinois and Iowa, Indiana, Missouri, and probably into other states farther east. The exhibit was arranged and the car is being run under the direction of F. A. Miller, General Passenger Agent.

The St. Paul uses an original plan to make sure that the stereopticon lectures will be well attended. Before the car goes to a place as complete a directory as possible is secured

Chicago, Milwaukee & St. Paul Exhibition Car.

There are really four distinct exhibits, one for each of these states. Besides the agricultural products there are also a number of mineral products from along the line, especially coal. Exterior and interior views are shown in the accompanying illustrations.

The car is accompanied by one or more representatives of the road, who give free stereopticon lectures at points where stops are made. The pictures shown are intended to give an idea of the appearance of the country. They include views of the new towns that have sprung up and also of the scenery along the line.

of the townspeople and of the farmers in the surrounding country, and to every person whose name is on the list a card is mailed, telling when the car will arrive and when and where the lecture will be delivered. Large posters are also put up through the surrounding country giving the same information. Illustrated literature is distributed at the meeting. The lectures have everywhere been largely attended.

Interior of St. Paul Exhibition Car.

LABOR RELIEF IN PRUSSIA.

Inquiries having been made in the Prussian Parliament as to what the government was doing to relieve the suffering of those thrown out of employment by the depression in trade, the Minister of Public Works said that as early as January of last year the officials of his department had been instructed to give out work as far as possible, and that actually large bodies of men who had been dismissed by other industries had been employed in his department. The railways had never before done so much construction as in 1908; the year's expenditures on construction account will be about $84,000,000, against $73,000,000 in 1907, $48,000,000 in 1906, and smaller amounts in previous years. This does not include expenditures for rolling stock, which is contracted for, and which were $57,000,000 in 1908, slightly less than in 1907, but much more than in 1906. Only for track material the orders were materially less than in 1907, when they amounted to 849,000 tons, against 595,000 in 1906. In 1908 they were 746,000 tons. This year the department will furnish work for a very large number of men on two of the new deep-water canals.

The Minister has directed that the contracts for rails and other iron track materials for the coming fiscal year be awarded several months earlier than usual.

The indications are that the industrial depression in Germany, which, while marked, has been less severe than in this country, continues unabated. Freight earnings of the German railways in November were 7⅔ per cent. less than in 1907, which is a greater decrease than in previous months. It is noticeable, however, that not only in November, but for the whole year, there has been a slight increase in passenger earnings.

ELECTRIFICATION OF MELBOURNE SUBURBAN LINES.*

BY CHARLES H. MERZ, M.INST.C.E.

IX.

The following table gives the number of sub-stations, and indicates the position of each sub-station for the different stages; it also gives the capacity of plant proposed to be installed.

*Sub-stations Required for the Different Stages.**

	Port Melbourne and St. Kilda Branches.		Stage I.		Stage II.		Stage III.	
	Names of sub-stations.	Capacity in kw.	Names of sub-stations.	Capacity in kw.	Names of sub-stations.	Capacity in kw.	Names of sub-stations.	Capacity in kw.
1	South Melbourne	4,500	South Melbourne	4,500	South Melbourne	4,500	South Melbourne	4,500
2			Pascoe Vale ..	1,500	Pascoe Vale....	1,500	Pascoe Vale....	1,500
3			North Melbourne	3,000	North Melbourne	4,500	North Melbourne	6,000
4			Richmond.	3,000	Richmond.	6,000	Richmond.	6,000
5			Balaclava.	3,000	Balaclava.	3,000	Balaclava.	4,500
6			Brighton Beach...	1,500	Brighton Beach...	1,500	Brighton Beach...	1,500
7					Newport..	3,000	Newport..	3,000
8					Camberw'l	3,000	Camberw'l	3,000
9					Blackburn	1,500	Blackburn	1,500
10							Caulfield..	4,500
11							Spring Vale....	1,500
12							Mentone..	1,500
13							Clifton Hill.....	4,500
14							Ivanhoe..	1,500
15							Bell.....	1,500
16							Brunswick	1,500

*The sub-station capacities given in this table are on the two-hour rating.

Generally, the sub-station equipment consists of:—

(1) High tension feeder panels, equipped with oil switches.

(2) High tension machine panels, equipped with oil switches.

(3) Rotary converter sets, each consisting of a 12,000/550 volt three-phase stationary transformer and a rotary converter specified to give 1,000 kw. continuously, and 1,500 kw. for two hours, with momentary outputs up to 3,000 kw.

(4) Direct-current switchboard for controlling rotary converters and feeders to conductor rail.

(5) Lighting equipment, air compressor for cleaning, ventilating fans, and all auxiliaries.

The three-phase electric energy generated at Yarraville will be transmitted to the sub-stations at 12,000 volts, and this may be done either by overhead wires or by underground cables, or partly by one method and partly by the other. As we do not require, with the 800 volt direct-current system chosen, any overhead wires for distributing the current from the sub-stations to the trains, we recommend that advantage be taken of this to avoid all overhead wires in the central area; that is, between the Power Station, on the west, and Richmond, on the east. The cost of four alternative arrangements, as between overhead wires and underground cables, is given in the following table:

Cost of Overhead Lines and Underground Cables.

	Port Melbourne and St. Kilda Branches.	Stage I.	Stage II.	Stage III.
1.—Underground cables throughout.	£27,301	£75,653	£119,472	£211,776
2.—Underground cables to Richmond, round the inner circle and to Camberwell, Caulfield and Balaclava—overhead lines elsewhere.....	27,301	67,562	102,996	176,238
3.—Underground cables to Richmond and round inner circle —overhead lines elsewhere..	27,301	63,555	93,293	159,962
4.—Overhead lines throughout, with duplicate lines on steel poles in central area.....	18,453	47,469	67,324	113,533

In my estimates I have included alternative 3 which I recommend as giving somewhat greater security of supply due to the absence of overhead wires from the center of the city. There is no reason, however, why overhead lines should not be adopted throughout if you do not consider the extra cost of underground cables justified for the reasons stated or for the sake of appearance and convenience. Conversely, there is no technical reason why you should not adopt underground cables throughout according to alternative 1 if you consider the greater expense justified. The arrangement of feeders, both for

*Capital Cost of Power Station, Sub-stations and High-Tension Feeders.**

	Pt. Melbourne and St. Kilda branches.	Stages I.	Stages II.	Stages III.
Power Station:				
Foundations, quays, main circulating water pipes and sumps, and all brick and concrete wrk	£ 26,000	£ 33,600	£ 42,000	£ 52,500
Steel building and chimneys, boiler house equipment, pipe system, feed and sump pumps..	67,000	96,600	150,700	195,500
Main generating units, condensing plant, air and circulating pumps	59,000	78,500	118,000	157,000
Switchboard, wiring, auxiliary motors, etc.	13,000	19,000	26,000	36,500
Fitting shop and tools, stores, cranes, and sundry equipment.	6,300	7,300	8,400	9,500
Total capital cost power station	171,300	235,000	345,100	451,000
Sub-stations:				
Buildings and equipment	18,732	78,059	132,294	225,984
High-tension Feeders:				
High-tension feeders between power station and substations (on basis of Alternative 3, in preceding table)	27,301	63,555	93,293	159,962
Spares for power department...	4,000	9,743	9,743	9,743
Total	221,333	386,357	580,430	846,689

*Including freight, tariff, engineering and contingencies.

*Abstract of the Report to the Victorian Railways Commissioners on the application of Electric Traction to the Melbourne Suburban Railway System. Published by the courtesy of the commissioners.

the whole scheme and to deal with the lines covered by the different stages. Where more than one underground cable is required they would be laid on both sides of the track, thus giving greater security of supply. With the underground cables, test wires would be laid for recording the drop in voltage in the track, and telephone wires for communicating with the different sub-stations.

I suggest that the overhead lines should be erected by your own staff, the underground cables being laid by contract, the labor being provided by the railway department.

The high tension feeder cables will consist of three-core paper insulated, lead covered cables laid solid in wood troughing, or armored, according to their location. They are specified to stand a test pressure of 24,000 volts after laying, but a sample tested in the factory is not to break down under a two-minute test of 60,000 volts. The contracts for cables are arranged on a schedule basis and it is proposed that the work should be paid for per yard laid.

One of the accompanying tables gives a summarized estimate of the capital cost of the power station equipment necessary to deliver power to the conductor rail, including the high tension feeders and sub-stations.

OPERATING EXPENSES OF POWER DEPARTMENT.

	Port Melbourne and St. Kilda Branches.		Stage I.		Stage II.		Stage III.	
	No. of Men.	Cost per annum.	No. of Men.	Cost per annum.	No. of Men.	Cost per annum.	No. of Men.	Cost per annum.
Power Station—								
Operating Staff:								
Engineer in charge	3	£750	4	£1,000	4	£1,000	4	£1,000
Switchboard attendants	4	568	4	568	5	710	5	710
Telephone attendants	1	102	2	204	2	204	3	306
Head drivers	4	628	4	628	4	628	5	785
Assistant drivers	.	..	3	426	4	568	5	710
Head firemen	4	536	4	536	6	804	7	938
Under firemen	.	..	5	590	7	826	10	1,180
Water tenders	3	330	3	330	5	550	6	660
Cleaners	1	102	2	204	3	306	4	408
Coal and ash handling men	2	220	4	440	6	660	8	880
Total	22	£3,236	35	£4,926	46	£6,256	57	£7,577

Fixed Charges.	Cost, per annum.	Cost, per annum.	Cost, per annum.	Cost, per annum.
Power station operating staff: Wages	£ 3,236	£ 4,926	£ 6,256	£ 7,577
Repairs: Labor	1,100	1,500	2,250	3,000
Material	750	1,000	1,500	2,000
General:				
Clerical staff	120	150	200	250
Stationery, etc.	90	120	160	200
Supervision	300	350	400	500
Insurance:				
Boilers & staff	90	150	210	280
Total fixed charges (power station).	£5,686	£8,196	£10,976	£13,807
Fixed charges: Substations and high tension feeders:				
Operating wages, inc. insurance.	1,360	3,570	5,440	7,710
Stores, repairs & maintenance	1,269	2,123	3,495	5,080
T'l fixed charges:				
Substations	£2,629	£5,693	£8,935	£12,790
Power Dept.	£8,315	£13,889	£19,911	£26,597
Variable charges:				
Power Station—				
Coal, Oil, and stores.*	£9,210	£23,200	£41,450	£62,260
Total fixed and variable charges †	£17,525	£37,089	£61,361	£88,857

*Black coal at 12s. per ton. The price of black coal burned at Yarraville is taken at 12s. per ton as against 14s. per ton for that burned by steam locomotives, because the power station is especially designed to burn the poorest and smallest coal, which is obtainable at a low price, but which cannot be burned in locomotives. If anything, 12s. per ton is on the high side as compared with 14s.
†Power department.

The estimates given in this table are based on the use of black coal as, although the power station is specially designed to burn either brown coal, or black coal, it is only the latter that can be bought to-day as a commercial article in sufficient quantities for the production of the electrical energy required for the railways; if, when the scheme starts, brown coal should be obtainable in sufficient quantities, the saving made will, of course, depend entirely on the prices at which it can be delivered into the power station bunkers. I should hope this saving will be considerable.

As some of the material will not be manufactured in Australia it would take some time to obtain new parts, and hence the question of what spare parts should be kept in stock is very important. I have considered this very carefully, and have included in all specifications, schedules, to be filled in by the tenderer, giving prices for spare parts, the total estimated cost of which, for the power department, is included in this table.

Another table gives my estimate of the cost of operation of the power department for the different stages, including not only the power station itself, but also the high tension feeders and sub-stations.

(To be continued.)

GARY CLASSIFICATION YARD OF THE CHICAGO, LAKE SHORE & EASTERN.

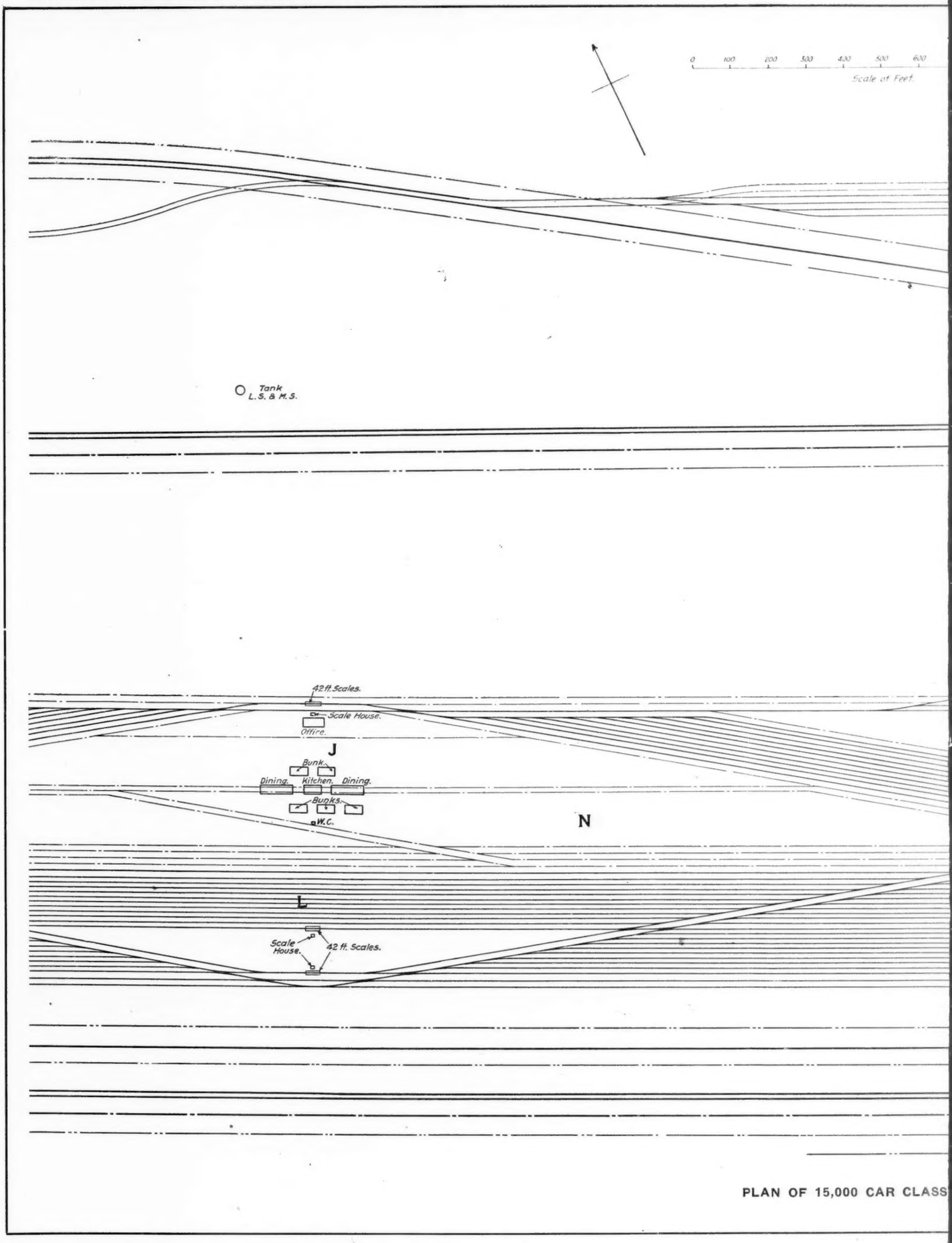
[WITH AN INSET.]

In preparation for handling the business of the Indiana Steel Company's plant—the new plant which the United States Steel Corporation is building at Gary, Ind.—the Chicago, Lake Shore & Eastern Ry., which is the connecting and switching road for the steel corporation's various plants in the Chicago vicinity, has made plans for a classification yard at Gary, having an ultimate capacity of 15,000 cars. One-third of this yard, or a capacity for 5,000 cars, has been built, a plan of this part being shown herewith.

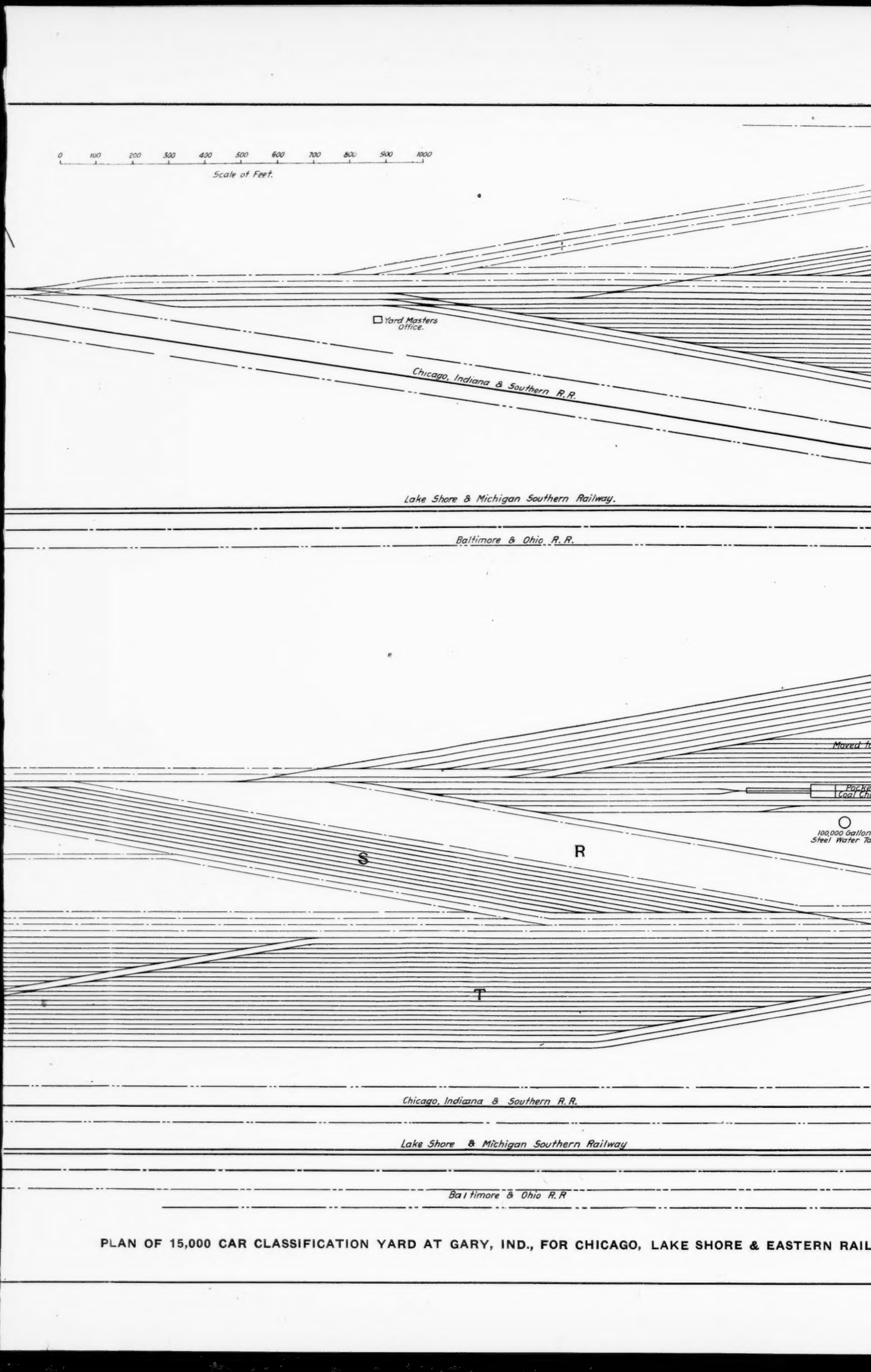
Two primary conditions governed the layout of the yard, one being the available length, which was limited by the location of the C., L. S. & E. on the west; and the other the fact that the larger part of the raw material and finished product will be handled through the yard in train lots. The tracks in yards F and T, the receiving yards respectively for incoming raw material and for finished product from the mills, are 2,600 ft. long, giving room for 52 cars. Trains of raw material coming into yard F are pushed by the yard engines over the scales at the throat between yards F and T, into the latter, where they stand until needed in the plant. Outgoing finished product is switched from the mills into yard T and thence across the scales into F, where the road engines take the trains. Less-than-train lots in either direction are handled similarly, being classified across the scales from one yard to the other. The scales in yard L can also be used in working between yards F and T.

Yards E and S supplement F and T, the movements through them being the same as for the larger yards. Empty cars awaiting finished product from the mills are passed over one of the three scales shown and stored in yards T and S. The construction of yards J, K and N, which are shown in outline above L, and of D and R, adjoining E and S respectively, will increase the capacity of the layout here shown to 7,500 cars. The ultimate plan provides for a duplication of this layout immediately north.

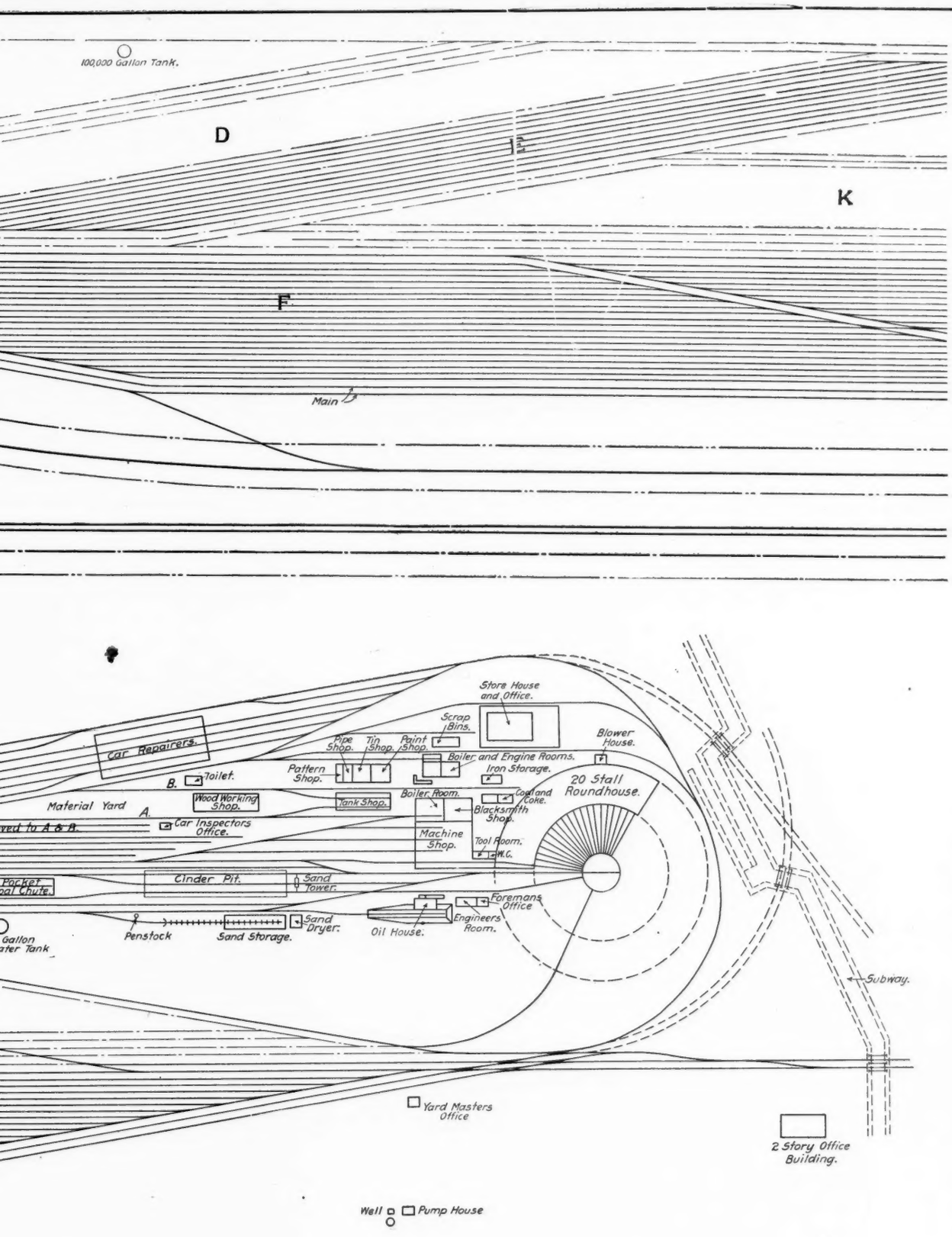
In connection with the yard, a new shop plant has been built. It is to be the general shops of the road, which has 125 locomotives and over 9,000 cars. The principal buildings are a machine, boiler and blacksmith shop under one roof; power house; engine house; car repair shop; woodworking shop; paint, pattern pipe and tin shop; tank shop; storehouse and



PLAN OF 15,000 CAR CLASS



PLAN OF 15,000 CAR CLASSIFICATION YARD AT GARY, IND., FOR CHICAGO, LAKE SHORE & EASTERN RAIL


100,000 Gallon Tank.
D
K
F
Main
Store House and Office.
Scrap Bins.
Blower House.
Car Repairers.
Pipe Shop.
Tin Shop.
Paint Shop.
Boiler and Engine Rooms.
Iron Storage.
B.
Toilet.
Pattern Shop.
20 Stall Roundhouse.
Material Yard
A.
Wood Working Shop.
Tank Shop.
Boiler Room.
Coal and Coke.
Blacksmith Shop.
Car Inspectors Office.
Machine Shop.
Tool Room.
W.C.
Cinder Pit.
Sand Tower.
Foremans Office
Engineers Room.
Sand Dryer.
Oil House.
Penstock
Sand Storage.
Subway.
Yard Masters Office
2 Story Office Building.
Well
Pump House

RAILWAY.

office building, and the usual locomotive terminal facilities. The principal shop buildings are brick and steel, with reinforced concrete tile roofing. In the case of the car shop, which will repair steel cars only, these roof tiles have inserted glass lights, there being 448 panes 12-in.x24-in., each set in the center of a tile. The roundhouse and machine shop are only 47 ft. apart, and as shown on the plan, are connected by a covered passageway which is wide enough to contain the tool room and a lavatory. The engine house, which has 20 stalls built, has a 70-ft. Pratt type turntable designed for Cooper's E—60 loading.

The plant will be electrically driven by power from the steel mills. This is 6,600-volt, 25-cycle, three-phase current, and the power station of the shops is really a sub-station for transforming this current down to 440 volts for the motors, 50 volts for the incandescent lights, and, by means of a frequency changer, supplying the 100 or more arc lights of the shops and yards with 2,200 volt, 60-cycle, three-phase current. The power station also contains air compressors, pumps, etc., and boilers to furnish steam thereto as well as for heating and for the steam hammers. There is also a hot water wash-out system.

The locomotive terminal facilities include a coal chute of 100 tons storage capacity, a 100,000 gal. steel water tank supplying three 10-in. penstocks, and an ash pit 155 feet long, 45 ft. 6 in. wide and 10 ft. deep. The pit has three tracks, the middle one being for cars, and the whole is spanned by a gantry crane, traveling the length of the pit, with a clam-shell bucket to load the cars.

A car repair yard with seven tracks supplements the car shop on the west, and a number of storage tracks are provided just north of the coal chute. A track encircles the engine house and connects with the east end of the car repair yard so that cars may be moved into and out of it from either direction.

The plans for the yard and shops, and their construction, were in charge of A. Montzheimer, Chief Engineer of the road. The yards are laid with 85 lb. rails and about 50 miles of track already has been laid.

WORK OF ENGINEERING STAFF IN VALUATION OF WISCONSIN STEAM RAILWAYS.*

BY WM. D. PENCE, M.A.S.C.E. †

The engineering staff which jointly serves the Wisconsin Tax Commission and the Railroad Commission of Wisconsin was organized in June, 1903, under authority of the law providing for the assessment of the steam railway properties of the state on an *ad valorem* basis. The size of this staff ranged from a maximum of about 25 engineers and inspectors at the busiest portion of the first year's work, down to the minimum of two persons assisting the chief engineer after the completion of the initial valuation report. Upon this latter basis it was found to be practicable to carry forward the annual revaluations of the steam road properties. In February, 1906, the first incumbent in the position of engineer for the Tax Commission resigned, and his successor was appointed (July 1, 1906) to render joint service for the Tax Commission and the then recently created Railroad Commission of Wisconsin.

The 1905 law prescribing the *ad valorem* basis of assessment for street railway properties provided for the valuation work to begin on the initial inventory date of June 30, 1907, but the work was actually undertaken some six months earlier than that date because of a complaint lodged with the Railroad Commission respecting street car fares in the city of Milwaukee. To meet this emergency the staff was reorganized and greatly extended in January, 1907, and since that date a staff of from 20 to 30 members has been required continuously to meet the joint demands of the two commissions. Immediately upon the completion of the Milwaukee valuations in July, 1907, the field work for the valuation of the physical property of the remaining street railway and associated lighting companies of the state was undertaken, and before the completion of that work active service under the newly-enacted public utilities law was inaugurated. Numerous inspection duties have also arisen in connection with several other laws recently enacted or amended.

The staff engaged in the 1903 steam road valuation work was organized under three general heads or chiefs of departments, respectively responsible to the chief engineer for the valuation of the permanent way, the lands and the mechanical features. With the reorganization for the purpose of making the street railway valuations, there were still but three heads, the land valuations being associated with the "roadway" group, and an electrical department added. Under the still wider scope to the work of the staff arising under the administration of the public utilities law within the past year or so, the civil and mechanical engineering groups have been extended to cover water works plants, the electrical engineering group to include telephones, and two additional groups or departments have been established, viz., gas engineering and the department of gas and electric service inspections.

In its present form the working organization includes the following groups or subdivisions: (1) Administrative, (2) office staff, (3) civil engineering staff, (4) mechanical engineering staff, (5) electrical engineering staff, (6) gas engineering staff, (7) gas and electric service inspections, and (8) miscellaneous.

The basis of appointment of the staff is provided for in part by a formal rule of the Civil Service Commission, and in part by special authorizations given from time to time by the Railroad Commission for the employment of experts under the provisions of the public utilities and railroad commission laws.

Membership on the staff is based upon ascertained fitness for the special service for which the appointment is made. There is entire freedom from political or other influence both in the matter of appointment and in the tenure of position on the staff. The tenure of service has been steady, the roll, except for the additions, being much the same as that established early in 1907. The practice followed by the Railroad Commission in its other departments of service of requiring each employee to report daily the actual hours devoted to the state work is observed by the technical staff.

The present membership of the technical staff consists almost exclusively of graduates of engineering schools, and about 60 per cent. of the permanent staff are graduates of the University of Wisconsin. Seven members of the regular staff are also members of the faculty of the College of Engineering, University of Wisconsin, among this number being the engineer in charge, the chief mechanical inspector and the expert on light and heat. Five other members of the teaching force of the engineering college also render occasional service on the commissions' staff. It is proper to say in this connection that this is but one of many instances in Wisconsin of active participation by university men in professional service on behalf of the state. Such participation is encouraged by the board of regents and president of the university, both on account of a recognized obligation to the state which provides support, and because of the stimulus given to the work of the university through outside contact of this kind.

VALUATION WORK BY THE STAFF.

The valuations reported to the commissions by the engineering staff have been confined throughout to the physical property, without regard to intangible elements. For a given inventory covering the items of any particular property, a definite value is fixed upon a fair basis as to unit prices, etc., and the results are reported by the staff at a definite amount, irrespective of the uses to which the figures are to be applied.

*Extracts from a paper read before the Western Society of Engineers of Chicago, December 16, 1908.

† Engineer, Railroad Commission of Wisconsin and Wisconsin Tax Commission; Professor of Railway Engineering, University of Wisconsin.

These determinations are, by intention, entirely free from bias. Every reasonable effort is made to get at the exact truth in regard to local conditions. The figures are subject to revision upon finding evidence of defects of inventory, errors of judgment, or other element likely to vitiate results. After submitting the valuation reports to the commission opportunity is given for further conference and hearing upon any or all items of the physical valuation.

In certain public utilities cases the owners, and in a few cases the cities as well, have employed experts to give testimony on values before the Railroad Commission. In one or two such cases the state engineering staff has submitted to the representatives of the utilities company and the city an "informal" valuation report to serve as a basis for preliminary conference and discussion. This preliminary report, after due consideration in the light of added data and information, is succeeded by the "tentative" valuation report which is submitted to the Railroad Commission as a part of the formal record in the case to be considered with other evidence. Before making up a final decision in the case the commission gives the engineer an opportunity to review the record and submit a supplementary report, in which are presented revisions or comments bearing upon the original or "tentative" valuation report.

The valuation work performed by the engineering staff falls under four heads, viz.: (1) Valuations of the physical property of the steam railways of the state, (2) of the street railway and associated properties, (3) of the public utilities properties, and (4) of public service corporation properties in connection with stock and bond issues. The accompanying tabulation includes the total valuations for one year's work each for the steam railway and electric railway properties, and all of the physical valuation work thus far reported upon under the public utilities and bond issue laws, the last two classes covering a period of somewhat more than a year's time.

Summary of Recent Physical Valuations.

	Cost of reproduction—Property new.	Cost of reproduction—Present condition.
(*a*) *Steam Railway Properties:*		
Fifty-two (52) properties aggregating 7,090 miles; inventory date June 30, 1907; fourth annual revaluation under the 1903 ad valorem law	$244,128,868	$196,239,314
(*b*) *Street Railway Properties:*		
Twenty-four (24) street and interurban properties with ten (10) associated lighting and heating properties; inventory date, June 30, 1907; first valuation under 1905 ad valorem law	26,783,620	21,208,010
(*c*) *Public Utilities Properties:*		
Twenty-four (24) public utilities properties; varying inventory dates; valuations under 1907 law	6,405,521	5,440,605
(*d*) *For Stock and Bond Issues:*		
Five (5) properties valued and reports made under 1907 law	305,576	270,008
	$277,623,585	$223,157,937

VALUATIONS OF PHYSICAL PROPERTY OF WISCONSIN STEAM RAILWAYS.

The Tax Commission, by authority given in section 27 of the steam railway assessment law, on June 3, 1903, appointed as its expert engineer Prof. Wm. D. Taylor*, Professor of Railway Engineering, University of Wisconsin. Under instructions from the Commission, Mr. Taylor consulted with Prof. Mortimer E. Cooley, of the University of Michigan, under whose direction the Michigan railway appraisals of 1900-1901 had been made. Acting upon the information and valuable suggestions furnished by Mr. Cooley, the preliminary plans for the Wisconsin appraisals were developed in a comparatively short time, and certain features of the Michigan methods were improved upon. The most important difference in the basis employed in the two state appraisals related to the method of working out the inventories, and to the extent to which the state staff made actual detailed field inspections of the physical property. In the Michigan appraisals the state staff took the initiative in preparing the inventories and made extensive and independent field examinations of the railway property. This work was then largely duplicated by the companies themselves, so as to be able to check up the figures obtained by the state staff, and to an extent a third process was required in the final compilations in order to reconcile the two more or less independent appraisals.

With a view to eliminate this costly and seemingly unnecessary repetition of work the Wisconsin Tax Commission, upon the advice of its engineer, suggested to the representatives of the important lines of the state that the companies undertake to inventory and value their own properties for submission to the board. To this suggestion the companies readily assented, and in the plan of work subsequently adopted it was arranged that any portion or all of the inventoried property might be reviewed by the state staff, according to the judgment of the commission's engineer. Such reviews of the valuation when finally made fully confirmed the spirit of good faith with which the representatives of the roads responded to the open-minded attitude of the commission and its engineer toward the companies; and it may be added that the spirit of fairness inaugurated in the initial appraisals has prevailed throughout the successive annual revisions of the steam road valuations.

In view of the very complete presentation of the methods employed on these earlier steam road valuations heretofore published* it is deemed unnecessary to give space to a repetition of the same in this connection.

Mr. Taylor at the conclusion of his report to the State Board of Assessment above referred to, makes the following comment with regard to the matter of keeping the valuations up to date by annual revisions:

> It should not ever again be necessary to make as expensive an investigation as this has been to determine the value of the tangible railway property of the state. And if the future assessments for taxation are to be in any wise determined by the value of railway physical property, and if a rate-making railway commission is to be constituted in the state which shall give any weight whatever to the investment in physical property in deciding upon rates for freight and passenger traffic, it will be necessary to keep the appraisal of these properties reasonably well up to date. It has been said that no item of railway property, tangible or intangible, remains constant in value. Traffic and the value of land and terminals fluctuate with the tide of business prosperity. Rolling stock, rail and structures all depreciate and the roadbed appreciates with use. Thus it seems that with this appraisal as a basis it would be advantageous to work the appraisal of the roads over again annually. Counting upon the assistance of the railways this can be done with a comparatively small force and at comparatively small annual expense.

In line with the foregoing plan the engineer had previously supplied to each railway company a copy of the corrected detail summary sheets pertaining to its property, and early in 1905 also sent to each road two sets of blank report forms relating to the physical property in detail, stamped, respectively, with the words "Deductions from property, June 30, 1903, to June 30, 1904," and "Additions to property, June 30, 1903 to June 30, 1904." These blanks when filled out and returned to the engineer formed the basis of revisions of the original appraisals of 1903 whereby the valuations were brought up to the second inventory date of June 30, 1904.

With reference to the rate of progress on such work some interest attaches to the "lag" or interval of time elapsing from the nominal date of inventory for the steam road valuations to that of final completion of the valuation report. This interval for the several valuations has varied as follows:

1st	valuation,	inventory	of	June 30, 1903,	16	months
2d	"	"	"	30, 1904,	14½	"
3d	"	"	"	30, 1905,	11½	"
4th	"	"	"	30, 1906,	14	"
5th	"	"	"	30, 1907,	17	"

In explanation of the above figures, it may be stated that

* Professor Taylor served as engineer to the Wisconsin State Board of Assessment until February 1, 1906, when he resigned to become Chief Engineer of the Chicago & Alton Railway. His successor was appointed on July 1, 1906, to serve the two state commissions jointly.

*See Report of Wisconsin Tax Commission, 1907, pp. 269-293.

in the initial or pioneer valuations as of inventory date June 30, 1903, there were the unavoidable delays incident to the organization of the staff, the formulation of plans for the work, and other elements entering into the earlier steps of any undertaking of large magnitude. In the annual revisions the chief cause of delay has been the time required by certain railway companies in the preparation of their reports of additions and deductions. The third report (second annual revision) was compiled under exceptionally favorable circumstances. The fourth required a longer time to complete, partly because of a delay in the receipt of reports of property changes on one or two of the larger roads, and in part by the fact that the engineering staff was engaged for the first time in the valuations of street railway properties. The increased time required to compile the fifth and most recent steam road report (as of date June 30, 1907) was due mainly to unusual demands upon the staff in connection with valuations and inspections uder the public utilities law late in 1907. By increasing the size of the staff somewhat in one department and assigning certain of the staff members exclusively to the valuations for taxation purposes, it appears that the steam and electric road valuation reports may hereafter be compiled within less than a year of the date of inventory.

PROPOSED REVISIONS OF METHODS.

The plan above described has been followed in each of the several successive annual revisions up to and including the fifth. In the 1903 plan the cost of reproduction was "assumed to be what it would cost to reproduce the road at the average prices prevailing for the period of five years ending June 30, 1902," that is, one year preceding the date of inventory. Through the excellent spirit of co-operation which pervaded the 1903 valuation work a series of unit prices based on the above assumption was worked out and adopted. While it has been practicable to make annual revisions in the unit prices for steel rail and a few similar materials subject to current market quotations, there have been no systematic revisions in the unit prices with respect to many kinds of the physical property involved in the inventories of these steam road properties. Five years have elapsed since these valuations were undertaken, and during this period there have been many radical changes in the cost of labor and materials involved in railway construction. Notwithstanding the temporary reaction in prices during the past year or so, it is certain that some important items, such as ties and structural timber, will never resume their former basis of cost.

Another matter which requires careful consideration in this same connection is the advance in land values throughout the state. No account has been taken of this factor in the annual revisions, the land values originally established having been used without change in the annual revaluations. There is also need to investigate further the matter of ratio of cost of acquiring rights-of-way as compared with the normal or average local land values for other than railway purposes, and these studies should be carried still further to cover the cost of acquiring lands for terminal purposes in the larger cities.

Recent conferences with railway officials touching the foregoing matters indicate that the railway companies are desirous of co-operating in any steps designed to maintain the valuations on the high standard established in the original valuation work of 1903-1904. As a result of these conferences and of discussions with the state commissions a critical study of the methods heretofore used in the various Wisconsin valuations and in those of other states is being made by the staff with a view to recommend improvements upon the present practice wherever practicable. It now appears that these revisions of method may be carried into effect, at least in part, in making the next (sixth) steam railway valuation report.

SERVICE INSPECTIONAL WORK BY THE ENGINEERING STAFF.

In exercising the broad powers conferred upon it with respect to service regulation of railway, express, telephone, and the municipal utilities companies, it has been the uniform policy of the Wisconsin Railroad Commission to insist upon adequate service, but without undue intrusion upon the routine of actual management. The inspections of service made by the technical staff under instructions from the commission are directed primarily to the actual results. When the results are found to be unsatisfactory, the commission frankly reports the facts to the company and also to the complainant, if any, with such recommendations or suggestions as may seem necessary or desirable. In the more important matters publicity is usually given through the daily press in order that the general public may be kept fully informed. Such publicity is often the only means of fixing in the public mind the responsibility for poor management or in establishing substantial justice where there have been false reports or wrong impressions as to the facts. As a general rule, the suggested improvement of service is made by the management without contest or delay. In the exceptional case the commission does not hesitate to use the mandatory powers conferred upon it by statute.

RAILWAY SERVICE INSPECTIONS.

The Railroad Commission of Wisconsin has not as yet adopted the plan of employing special inspectors to engage exclusively in investigations of railway service, although such inspectors may ultimately be required with reference to certain of the more technical phases of railway operation. Provision is made by the law for the employment of the requisite expert help when the need for the same arises. Such matters are at present investigated by the engineer personally or by special assignments from the technical staff, and reports submitted for the information of the commission.

An interesting experiment recently inaugurated by the commission is intended to bring together accurate information regarding the railway service of the state as seen by the ordinary or casual passenger. Under special instructions from the commission each member of the technical staff submits written trip reports covering his observations while en route about the state on valuation work or other commission business. The character and scope of these observations are indicated by the headings given below, taken from a blank form prepared with a view to secure some degree of uniformity in the facts thus reported to the commission.

TRIP INSPECTION REPORT.

ENGINEERING STAFF, RAILROAD COMMISSION OF WISCONSIN.

Report by ..... Observations on Train No. ....., ...
Ry. Between ..... (.....M) and ..... (.....M)
..... 190....
(Use additional sheet if more space is needed.)

1. *Train Service:* Running Schedule—On time or late; if late, actual amount and amount slated, causes, etc.; speeds, etc.
.....
.....

2. Train Equipment—Coaches: number and kind; crowded or otherwise; cleanliness, ventilation and sanitary condition (cars and toilets); sleepers.
.....
.....

3. Train Employees—Engineer: care in running, testing air, etc.; conductor, brakemen, flagmen, etc.: treatment of passengers, calling stations, guarding rear end, etc.; Pullman and dining-car service.
.....
.....

4. *Station Service:* Employees—Agent, baggageman, caller, etc.; conduct, attentiveness, intelligence, announcing trains, etc. (give names of stations).
.....
.....

5. Station—Waiting rooms and toilets; cleanliness, sanitary condition, ventilation, heating, etc.; platforms; grounds; waiting shelters, etc.
.....
.....

6. *Miscellaneous:* Track; bridges; crossings (obstruction or protection); safety appliances; train connections at junction points, etc.
.....
.....

7. *Pasengers*: Department; demands on employees; hand baggage, etc.
.....
.....
(Date)..... (Sign).....

It should be stated that the initial instructions regarding these trip reports were given in such manner as to make it

plain that the observer was not expected to engage in "detective" work and that, at least until further instructions were given, the observations and comments were to be only such as might reasonably be made by any ordinary traveler at any station or on any train. Many of the comments in these reports are of an entirely favorable character, as they obviously should be to represent the actual conditions in many instances. The intermingling of these favorable comments with the often pointed criticisms as to defects of service gives emphasis both to the good and the bad features and commands the attention and respect of the railroad management. A tabulated summary of the trip reports is prepared covering each month's observations and a copy of the monthly summary transmitted to the general manager or other responsible official of each road concerned with such report. The responses of the railway companies indicate entire readiness on their part to co-operate in this movement for the betterment of the railway service of the state.

However, these casual observations are not intended in any sense to do away with inspections of a more technical and rigid kind. It is found in practice that the need for the more searching inquiry is often revealed in the course of the routine investigations above described. Under the Wisconsin law and practice the members of the inspectional staff purchase tickets and travel like other passengers.

GETTING OVER HIGH GROUND.

BY J. A. MACDONALD, C.E.

The following somewhat novel method of getting a preliminary railroad line over high ground may be of interest. The care taken and the several traverses and numerous offsets in this work is partly explained by the nature of country and the fact that the line was practically what is termed a preliminary location.

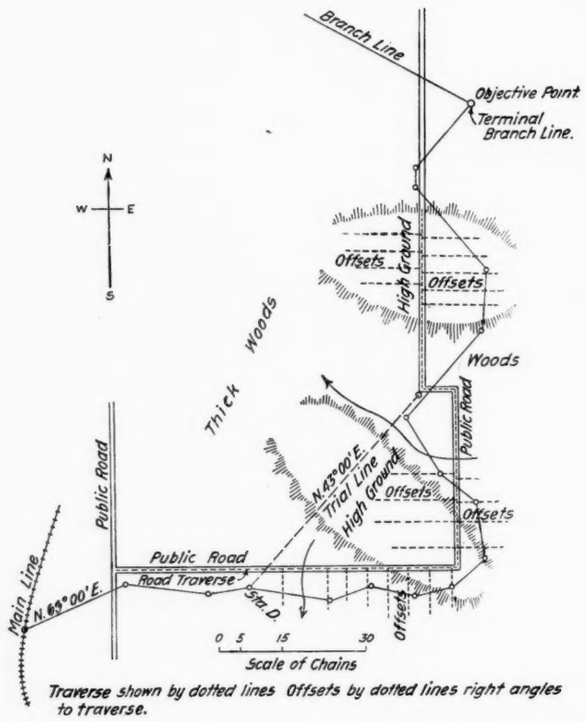
A reconnaisance was made by the chief engineer, driving along the public roads, shown in the plan, the only instruments being an aneroid and a prismatic compass. This was a simple matter so far as it went. Having a map of the country the chief engineer drew a line roughly about the way it is now shown on the accompanying sketch. This was a long way round to reach the objective point, which was the terminal of a branch as shown. The cross-country route, shown by the trial line, was the favored route if feasible, but owing to this route being covered with a dense forest of spruce the chief engineer had no data as to its feasibility for a railroad route, and so the instructions were to take this shorter and more direct route if at all possible.

The first done was to make a traverse of the public road. As will be seen, these roads ran parallel with the cardinal points. Levels were taken all along these traverses and a profile made. It was found in places, as shown on the sketch, the ground was very high, involving heavy and deep cuttings. The problem then was to get a line in which the cuttings would be as light as possible without unduly lengthening the line. It was also necessary to see that when the curves were run in that no deep cuts would be involved. For this reason the external secant was scaled frequently, and the degree of curve suitable to the ground was sketched and the line moved in or out to suit the curve. This line, therefore, was what may be called a preliminary location.

After the traverse was made along the roads offsets were taken at the high places, five or six chains apart, and extending well in on either side. Levels were taken on all of these offsets. In this way a topographical map of the country was soon made.

The line started from the main line, and when Station D was reached a bearing of N. 43 deg. E. was obtained from the plan in order to strike the corner of the road where there was an L. This was through a thick woods. It was found to be a very uncommon country. The ground was quite high about the middle and strangely of a marshy nature on the apex of the hill. Were the ground not of this nature it is probable that the line would go through here. But as it meant a long deep cut through marshy ground, it was decided that such was untenable, and so this line was abandoned and the round-about route was determined upon.

With the map of the country, and the topographical features and profiles, it was an easy matter to project a fairly



Traverse shown by dotted lines Offsets by dotted lines right angles to traverse.

Getting Over High Ground.

good line on the map, which was placed on the ground. The curves and external secants were plotted on the plan previous to running the line so that the line, on the ground, as shown in the sketch, was in every way satisfactory.

FOREIGN RAILWAY NOTES.

Siam in its last fiscal year added 125 miles to its railway system, bringing up the total to 357 miles, and had 122 miles under way. In the last year the working expenses were but 34⅔ per cent. of the gross earnings, and the net earnings amounted to 5.7 on the capital invested.

The death at Paris is announced of Wm. Nordlinger, in his time one of the most distinguished of European railway engineers. Born and educated in Stuttgart, he completed his engineering education in the French School of Bridges and Highways. After a very short service in his native country, he entered the French corps, for which he had been trained, and after much railway building became chief engineer of the Orleans Railway, then the greatest in France. In 1870 he became consulting engineer, with Max von Weber, in the Austrian Ministry of Commerce, and later was chief manager of the State Railways. During the building of the Arlberg Railway he left the Austrian service, and finally retired in Paris, where he devoted himself largely to promoting the interests of the Protestant church in France. He wrote many pamphlets, notably one on the social position of engineers in Germany, which he contrasted very unfavorably with their position in France.

SOUTHERN PACIFIC DRAFT GEAR TESTS.

In connection with the elaborate tests of the improved Westinghouse air brake, on the Southern Pacific during the past summer, tests were also made on the Los Angeles division to show the advantage of the Westinghouse friction draft gear in freight service.

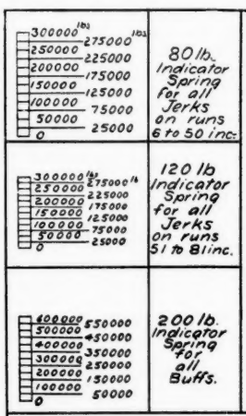
Comparative demonstrations were made with two trains of fifty 12,430 gal. oil cars and dynamometer car each. One train was equipped with Southern Pacific Company's standard tandem spring draft gear and type H quick action triple valves, and the other was equipped with Westinghouse friction draft gear and type K triple valves. Dynamometer car and slidometer were used for the purpose of obtaining records of shocks from buffs and jerks, also speed of train and were located in train as noted on following tables and diagram:

The first tests, 1 and 2, were to determine amount of slack and recoil in trains before and after the demonstrations. It was found that there was not much difference in the slack in the trains with the different types of gear, but the difference in the amount of recoil was remarkable, the greatest recoil recorded with the Westinghouse friction gear being 5 ft. or 1.5 in. per car, while with tandem spring gear the highest recoil recorded was 24 ft. or 7.3 in. per car.

The slack and recoil were taken by applying rear hand brake and moving train back to gather loose slack, then stopping train and setting air brakes on 10 rear cars in emergency, the engine then shoving the remaining 40 cars back into the 10 rear cars until stalled, using full throttle. The rail was marked at forward wheel of first car and at rear wheel of fortieth car, after which the engine was put into forward motion and with full throttle pulled train steadily until stalled. Points on rail were again marked under wheels of first and fortieth cars as previously mentioned and record taken of distance between the marks. The independent brake was then applied on engine to hold slack stretched until engine could be reversed, throttle closed, cylinder cocks opened, then independent brake was released and engine allowed to roll backward freely. The rail was again marked and measured for recoil.

Test 3 was made to determine and illustrate the value of both types of gear in destroying the effects of jerks such as regularly occur in service; an anchor was made of the 10 rear cars and engineer was instructed to take all the slack left in balance of the train by backing the 40 cars against the anchor, and trying, by using full throttle, to part the train. The dynamometer car was placed just ahead of the anchor (forty-first car), and photographic reproductions of the interesting data secured, illustrating that the friction gear softened the jerk to less than one-half that obtained with spring gear.

Test 4 was made to determine the comparative values of the gears for destroying shocks in the train produced by the en-



SHEET No 0.

SOUTHERN PACIFIC Co's.

Comparative Draft Gear Tests With trains of 50 S.P.Co's 12430 Gals. Capacity Oil Cars equipped with

TANDEM SPRING AND WESTINGHOUSE FRICTION DRAFT GEARS.

Los Angeles Div. June 1908.

Note:- On attached sheets the diagrams are taken from Indicators piped to a hydraulic chamber which is connected by levers to the Coupler of one end of the Dynamometer Car. (No gear used on this end of Car) The Speeds are obtained by determining the number of revolutions per second of (33⅜ dia) wheels of Dynamometer Car.

Table of Speeds MPH corresponding to rev per sec of Dyn. Car wheels (33⅜ dia.)

Rev per Sec.	MPH	Rev per Sec.	MPH
.168	1	2.69	16
.336	2	2.86	17
.504	3	3.02	18
.672	4	3.19	19
.840	5	3.36	20
1.00	6	3.51	21
1.176	7	3.70	22
1.34	8	3.86	23
1.51	9	4.03	24
1.68	10	4.20	25
1.85	11	4.37	26
2.00	12	4.54	27
2.184	13	4.70	28
2.35	14	4.87	29
2.52	15	5.04	30

Orders of Runs.

Dems.	Types of Gears	Dems.	Runs.	Dates	Types of Gears.	Dems.	Runs.
6-11-08	Westing. house Fricf.	1	1*	6-13-08	Tandem Springs	6	A 38
"	"	A	2*	6-15-08	"	B	39
"	"	B	3*	"	"	C	40
"	"	C	4	"	"	7	41
"	"	D	5	"	"	A	42
"	"	2	1X	"	"	B	43
"	"	A	2X	"	"	C	44
"	"	B	3X	"	"	D	45
"	"	C	4X	"	"	E	46
"	"	D	5X	"	"	F	47
"	"	3	6	"	"	G	48
"	"	A	7	"	"	H	49
"	"	B	8	"	"	8	50
"	"	4	9	"	"	A	51
"	"	A	10	"	"	B	52
"	"	B	11	"	"	12	53
"	"	5	12	"	"	A	54
"	"	A	13	"	"	B	55
"	"	B	14	6-18-08	West'h. Fricf.	7	56
6-12-08	"	6	15	"	"	A	57
"	"	A	16	"	"	B	58
"	"	B	17	"	"	C	59
"	"	C	18	"	"	8	60
6-13-08	Tandem Springs	1	19	"	"	A	61
"	"	A	20	"	"	B	62
"	"	B	21	"	"	9	63
	"	2	19X	"	"	A	64
	"	A	20X	"	"	B	65
	"	B	21X	"	"	12	66
"	"	3	22	"	"	A	67
	"	A	23	"	"	B	68
	"	B	24	"	1st 25 Cars West. Fricf. 2nd 25 Cars Tand. Sprs.	13	69
"	"	A	25	"		A	70*
	"	A	26	"		B	71
	"	B	27	"		C	72
"	"	C	28	6-19-08	1st 25 Cars Tand. Sprs. 2nd 25 Cars West. Fricf.	14	73
	"	9	29*	"		A	74
	"	A	30*	"		B	75
"	"	B	31	"	"	16	76
	"	C	32	"	"	A	77
"	"	D	33	"	"	B	78
	"	5	34	"	1st 25 Cars West. Fricf. 2nd 25 Cars Tand. Sprs.	15	79
	"	A	35	"		A	80
	"	B	36	"		B	81
"	"	6	37	* Denotes Runs Voided.			

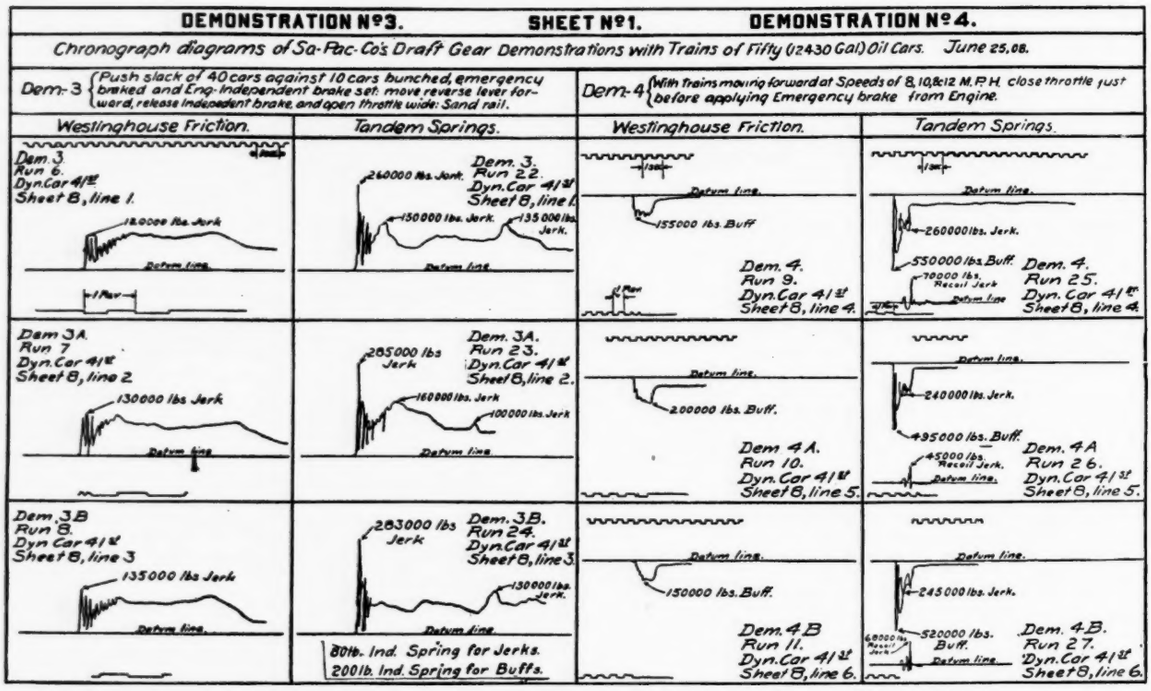
Index.

Sheet	Dems.	Runs.	Type of gears.	Tests.	Description
1	3	6-8, 22-24	Westingh. Friction. Tandem Springs	Jerk	To determine value of Gear in destroying effects of a Jerk.
	4	9-11, 25-28	Westingh. Friction. Tandem springs	Buff	To determine value of Gear for destroying shocks produced by emergency applications made at, or near, head end of Train.
2	15	79-81	1st 25 Westingh. Fricf. 2nd 25 Tandem Spr.	"	" " " "
	16	76-78	& Vice versa.		
3	5	12-14, 34-36	Westingh. Friction. Tandem Springs.	Jerk.	To determine value of Gear in reducing shocks resulting from air hose bursting, or Train parting near rear end with Engine working.
	6	15-18, 37-40	Westingh. Friction. Tandem Springs.	"	To determine value of Gear in reducing shocks resulting from air hose bursting, or Train parting, near rear end with Engine shut off.
4	7	41-49, 56-59	Tandem Springs. Westingh. Friction	"	Efficiency in dissipating shocks produced by rough handling when starting trains.
5	8	50-52, 60-62	Tandem Springs Westingh. Friction.	Release.	Release brakes at slow speeds and open throttle before rear brakes are released.
6	13	69-71-72	1st 25 Westingh. Fricf. 2nd 25 Tand. Sprs.	"	" " " " "
	14	73-75	& Vice versa.		
7	9	31-33, 63-65	Tandem Springs Westingh. Friction	Buff.	Protection to cars and lading while switching &c.
8	—	—	Recapitulation of all Tests (large sheet)		

Southern Pacific Draft Gear Tests.

Line	SHEET 8a. Demonstrations	Slack. Westinghouse Friction. Total for 40 Cars	Slack. Westinghouse Friction. Per Car	Slack. Tandem Springs. Total for 40 Cars	Slack. Tandem Springs. Per Car	Recoil. Westinghouse Friction. Total for 40 Cars	Recoil. Westinghouse Friction. Per Car	Recoil. Tandem Springs. Total for 40 Cars	Recoil. Tandem Springs. Per Car
1	1 & 2 Before Demonstrations	Void				Void			
2		"	on account of hump interfering with action.		in yard slack	"	on account of hump interfering with action		in yard slack
3		"		28'-3"	8.69"	"		21'-8"	6.67"
4		25'-5"	7.82"	28'-4"	8.72"	4'-1½"	1.27"	22'-9"	7.00"
5		27'-2"	8.36"	28'-6½"	8.78"	No Record		22'-9"	7.00"
6	1 & 2 After Demonstrations	22'-0"	6.68"	31'-3"	9.49"	4'-1½"	1.25"	23'-7"	7.16"
7		27'-0"	8.20"	31'-9"	9.64"	5'-0"	1.51"	21'-0"	6.37"
8		27'-11"	8.48"	31'-5½"	9.55"	2'-9½"	.85"	24'-1"	7.32"

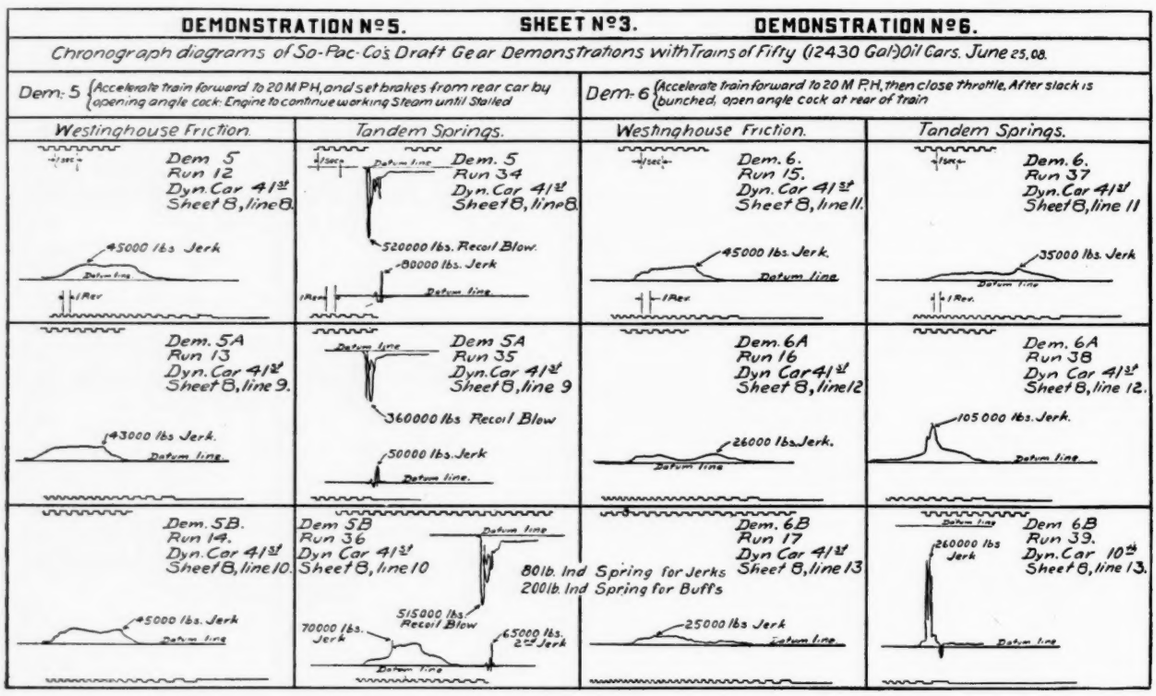
Record of Tests 1 and 2.



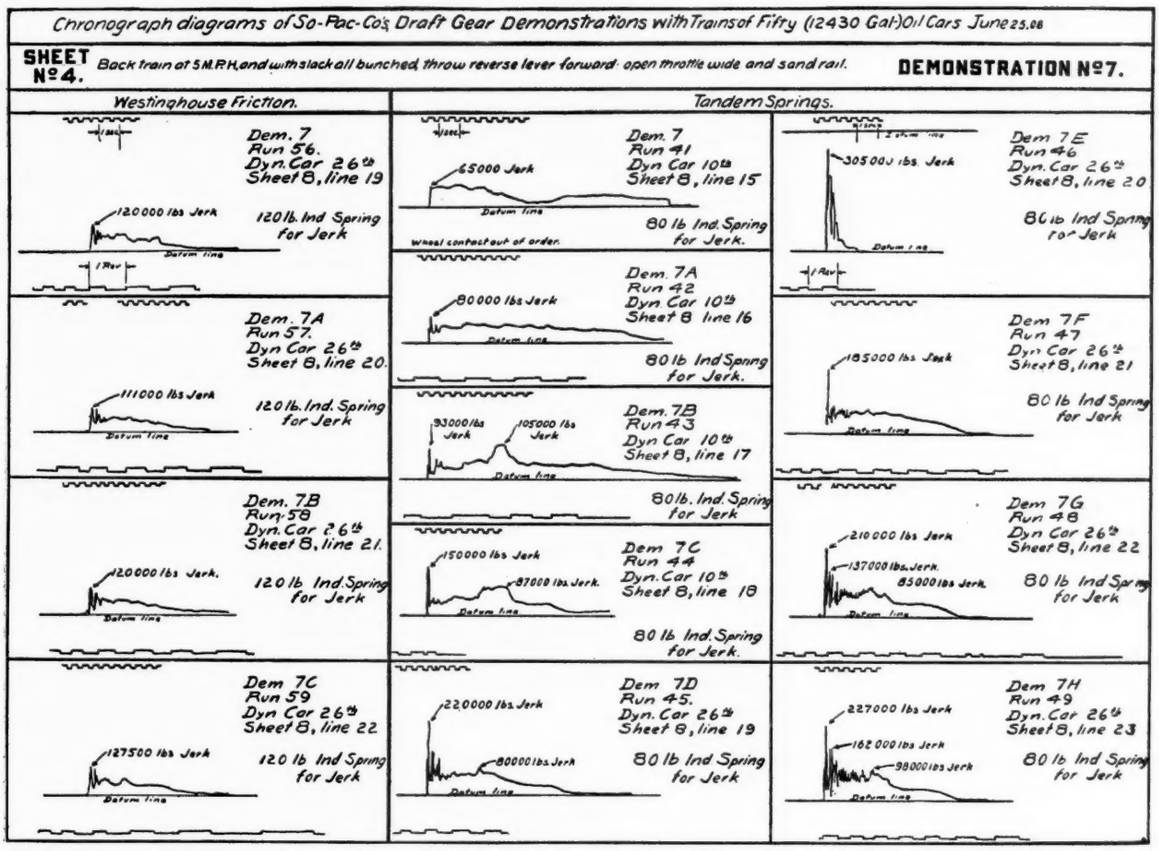
Record of Tests 3 and 4.

gineer making emergency application of brakes, which so frequently becomes necessary in service, or by hose parting at or near the head end of train (two engines, on head end pulling out of drawbar for instance) the trains were accelerated to approximately 10 miles per hour, the throttle closed just previous to movement of the brake valve to allow the train to drift, then an emergency application of the air brakes was made in the regular way with the brake valve. The friction gear diagrams show buffs from 150,000 to 200,000 lbs. and norecoil jerks, while the tandem spring gear shows buffs from 495,000 to 550,000 lbs. besides recoil jerks in every case from 45,000 to 70,000 lbs. The dynamometer car was placed in the back part of the train (forty-first car) to illustrate why lading is shifted and damaged en route, this particular demonstration representing an actual service condition.

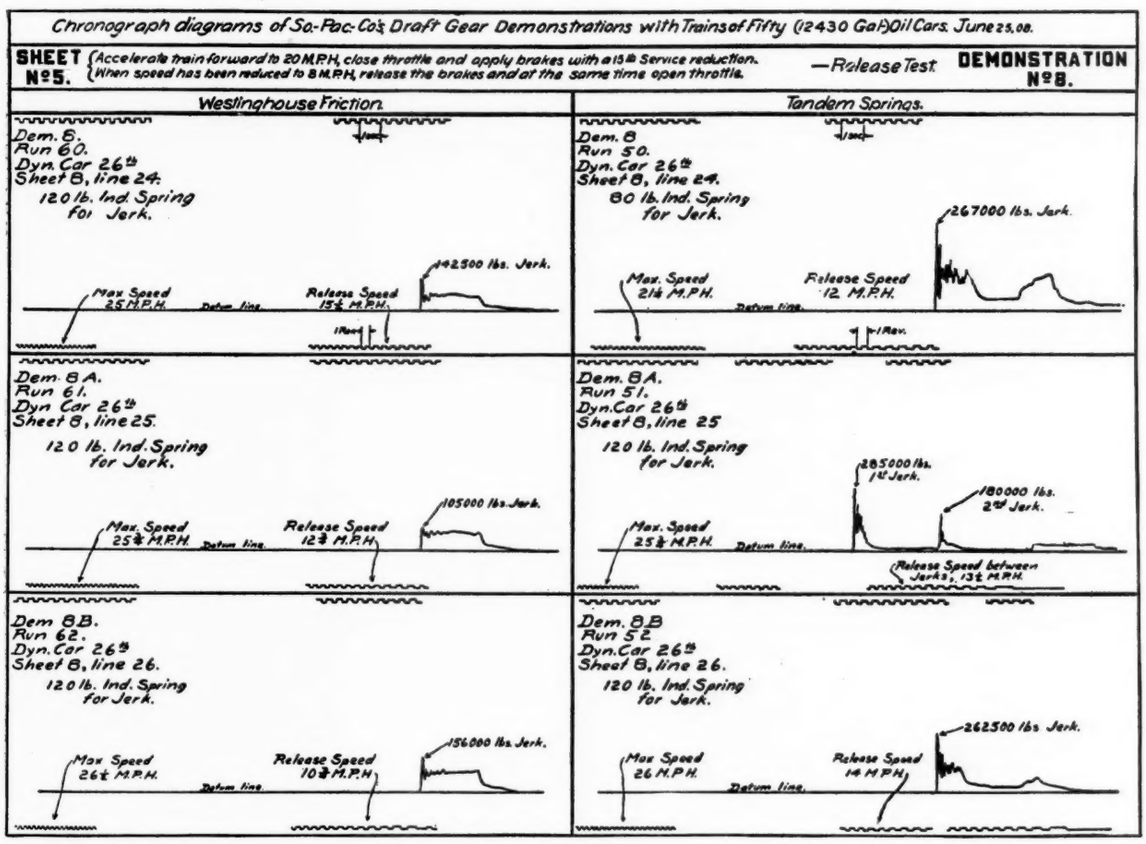
In test 5 an emergency application of the air brakes starting from the rear end of the train while en route and under full steam, such as occurs from hose bursting or train parting near rear end or by malicious or intentional use of conductor's valve in caboose, brings an entirely different condition than an emergency application made from the head end, and to determine the relative values of the draft gear under such conditions the trains were accelerated to a speed of about 20 miles per hour and the brake pipe was opened at rear end while the engine



Record of Tests 5 and 6.



Record of Test 7.



Record of Test 8.

RECAPITULATION OF SOUTHERN PACIFIC CO.'S COMPARATIVE DRAFT GEAR DEMONSTRATIONS WITH TRAINS OF FIFTY S. P. CO.'S 41-FT. OIL CARS, CLASS 0-50-2, CAPACITY, 12,430 GALS., EQUIPPED WITH TANDEM SPRINGS AND WESTINGHOUSE FRICTION DRAFT GEARS.

Tests made on Los Angeles Division, S. P. Co., June 11 to 18, 1908.

Line	Demonstration. Nos.	Demonstration. Description	Location of Dyn. car	Slideometer movements. Westinghouse friction. Dyn. car. Forward.	Back.	Car.	Forward.	Back.	Tandem springs. Dyn. car. Forward.	Back.	Car.	Forw'rd	Back.	1st 25 cars West.-fric.; 2d 25 cars tandem springs. Dyn. car. Forw'rd	B'k.	Car.	Forw'rd.	1st 25 cars tandem springs; 2d 25 cars West.-friction. Dyn. car. Forwrd.	B'k.	Car.	Forwrd.	Buffs and recoil blows. Westinghouse frict'n.	Tandem springs.	1st 25 West.-fr.; 2d 25 tndm	1st 25 tndm 2d 25 W.-fric.
1.			41st.	.....	2⅝"	1st.	No movement.		.....	7⅝"	1st.	No movement.													
2.	3	Jerk.	41st.	.....	3¹¹/₁₆"	1st.	No movement.		.....	7⁵/₁₆"	1st.	No movement.													
3.			41st.	.....	8½"	1st.	No movement.		.....	8"	1st.	No movement.													
4.			41st.	10⁸/₁₆"	.....	51st.	5'—0½"		1'—7¹⁸/₁₆"	.....	51st.	2'—6"	.....	7½"	....	51st.	11"	5¹³/₁₆"	.....	51st.	5¾"	155,000	550,000	350,000	95,000
5.	4	Buff.	41st.	1'—3¹⁵/₁₆"	.....	51st.	3'—0¼"		1'—1⅝"	.....	51st.	4'—2¼"	.....	1'—4¼"	....	51st.	3'—1"	1'—6⁵/₁₆"	.....	51st.	2'—9½"	200,000	495,000	550,000	200,000
6.			41st.	No record.		51st.	3'—10⅜"		7⅞"	Remrks.	51st.	3'—11"	.....	1'—1"	....	51st.	5'—2½"	1'—8¹⁵/₁₆"	.....	51st.	4'—7¾"	150,000	520,000	490,000	240,000
7.			41st.	.....	.....	51st.	.....		10⅝"	.....	51st.	5'—6"	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	530,000	.....	.....
8.			41st.	⅞"	.....	51st.	⅜"		1'—4⅞"	.....	51st.	1'—8"	.....	.....	....	.....	.....	.....	.....	.....	.....	No recl.	Rec. blw 520,000	.....	.....
9.	5	Jerk.	41st.	3⅝"	.....	51st.	5½"		11⅜"	.....	51st.	1'—8¼"	.....	.....	....	.....	.....	.....	.....	.....	.....	No recl.	Rec. blw 360,000	.....	.....
10.			41st.	1¾"	.....	51st.	7¼"		1'—4³/₁₆"	.....	51st.	1'—8"	.....	.....	....	.....	.....	.....	.....	.....	.....	No recl.	Rec. blw 515,000	.....	.....
11.			41st.	1/₁₆"	.....	51st.	¾"		¼"	.....	51st.	No movement.		.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.	6	Jerk.	41st.	1/₁₆"	.....	51st.	No movement.		1⅞"	.....	51st.	.....	¼"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13.			41st W.F§	1¹⁵/₁₆"	.....	51st.	1" at stop	¾"	1'—8⁹/₁₆"	.....	51st.	.....	½"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.			10th.	1'—0¹/₁₆"	.....	51st.	.....	5⅝"	1'—4¹⁵/₁₆"	.....	51st.	.....	¼"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15.			10th.	.....	.....	51st.	.....		.....	2⁵/₁₆"	51st.	.....	8"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16.			10th.	.....	.....	51st.	.....		.....	2⁵/₁₆"	51st.	.....	8¼"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17.			10th.	.....	.....	51st.	.....		No record.		51st.	.....	2'—4¼"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18.			10th.	.....	.....	51st.	.....		.....	3"	51st.	.....	2"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19.	7	Jerk.	26th.	4⁵/₁₆"		51st.	.....	4"	.....	8"	51st.	.....	1"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20.			26th.	3¾"		51st.	.....	7¼"	.....	10⅜"	51st.	.....	10"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21.			26th.	4¾"		51st.	.....	7¾"	.....	6⅝"	51st.	.....	1'—0¼"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22.			26th.	4¼"		51st.	.....	7¼"	.....	8⅜"	51st.	.....	1'—7½"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23.			26th.	.....	.....	51st.	.....		.....	9⁵/₁₆"	51st.	.....	1'—3½"	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24.			26th.	1¹³/₁₆"		51st.	No movement.		.....	9"	51st.	1½"	.....	.....	4⅜"	No record.		.....	6³¹/₁₆"	1st.	1⁹/₁₆"	.....	130,000	.....
25.	8	Jerk.	26th.	2"		51st.	.....	1'—6"	.....	9¾"	51st.	No movement.		Void.	.....	.....		.....	10"	1st.	1¼"	.....	.....	.....	.....
26.			26th.	3⁷/₁₆"		51st.	.....	1'—11"	.....	8⅜"	51st.	No movement.		.....	5"	No record.		No movement.		1st.	6¾"	.....	.....	.....	.....
27.			26th.	.....	.....	51st.	.....		.....	.....	51st.	.....		.....	5"	No record.		.....		.....		.....	.....	.....	.....
28.			11th.	.....	.....	51st.	.....		Void.	.....	51st.	.....		.....	.....	.....		.....		.....		.....	Void.	.....	.....
29.			11th.	.....	.....	51st.	.....		Void.	.....	51st.	.....		.....	.....	.....		.....		.....		.....	Void.	.....	.....
30.	9	Buff.	11th.	.....	1'—5⁵/₁₆"	3d.	.....	2'—11"	.....	5"	3d.	.....	4"	.....	.....	.....		.....		.....		.....	*k*600000	250,000	.....	.....
31.			11th.	.....	4¼"	3d.	.....	5"	.....	1'—1⅞"	3d.	.....	10"	.....	.....	.....		.....		.....		.....	*k*400000	450,000	.....	.....
32.			11th.	.....	3⁵/₁₆"	3d.	.....	6"	.....	11½"	3d.	.....	1'—1½"	.....	.....	.....		.....		.....		.....	*k*500000	390,000	.....	.....

§ 10th T. S.

Line	Jerks and recoil jerks. Westinghouse friction.	Tandem springs. 1st.	2d.	1st 25 West.-friction; 2d 25 tandem spgs. 1st.	2d.	1st 25 tandem springs; 2d 25 West. frictn. 1st.	2d.	Speeds, miles per hour. West.-friction. Engine. At Max.	At ret.	Dyn. car. At Max.	At ret.	Tandem springs. Engine. At Max.	At ret.	Dyn. car. At Max.	At ret.	1st 25 West.-fric.; 2d 25 tandem spgs. Engine. At Max.	At ret.	Dyn. car. At Max.	At ret.	1st 25 tand. spgs; 2d 25 West.-friction. Engine. At Max.	At ret.	Dyn. car. At Max.	At ret.	Train damage. Westinghouse friction. C	D	E	F	Tandem springs. C	D	E	F	1st 25 West. fric.; 2d 25 tand.spr. C	D	E	F	1st 25 tand. springs; 2d 25 West. friction. C	D	E	F
1.	120,000	260,000	.....	.....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2.	130,000	285,000	.....	.....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
3.	135,000	283,000	.....	.....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
4.	No recoil	Recoil jerk 70,000	.....	No recoil	.....	No recoil	.....	9½	....	12	....	8½	....	8	....	5	....	5½	....	5	....	5¾	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5.	No recoil	Recoil jerk 45,000	.....	No recoil	.....	No recoil	.....	5¾	....	8½	....	10	....	9¾	....	10	....	10¾	....	10	....	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
6.	No recoil	Recoil jerk 68,000	.....	No recoil	.....	No recoil	.....	7½	....	10½	....	13	....	12	....	12	....	12½	....	12	....	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
7.	.....	Recoil jerk 55,000	.....	.....	.....	.....	.....	....	....	....	....	13	....	12½	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1†	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8.	45,000	No jerk record'd	*s, t.* 80,000	.....	.....	.....	.....	17½	....	19¾	....	21½	....	16	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	..*	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9.	43,000	No jerk record'd	*s, w.* 50,000	.....	.....	.....	.....	17½	....	20¾	....	21	....	21	....	.....	.....	.....	.....	.....	.....	.....	.....	1	3	....	....	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
10.	45,000	70,000	*s*65,000	.....	.....	.....	.....	17¾	....	21	....	21½	....	22	....	.....	.....	.....	.....	.....	.....	.....	.....	..	1	1	..	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
11.	45,000	35,000	.....	.....	.....	.....	.....	19½	....	21½	....	19¾	....	21	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*	*g*1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
12.	26,000	105,000	.....	.....	.....	.....	.....	20½	....	23	....	19½	....	21¼	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
13.	25,000	260,000	.....	.....	.....	.....	.....	23	....	27	....	19¼	....	19¾	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14.	146,000	265,000	.....	.....	.....	.....	.....	20	....	20¼	....	20½	....	21	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	2	2	.....	.....	.....	.....	.....	.....	.....
15.	.....	65,000	.....	.....	.....	.....	.....	.....	....	.....	....	5¼	....	No record.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16.	.....	80,000	.....	.....	.....	.....	.....	.....	....	.....	....	4¾	....	5	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17.	.....	93,000	105,000	.....	.....	.....	.....	.....	....	.....	....	5	....	5¼	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18.	.....	150,000	.....	.....	.....	.....	.....	.....	....	.....	....	5	....	5	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19.	120,000	220,000	.....	.....	.....	.....	.....	5	....	5¾	....	5	....	6¾	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20.	111,000	305,000	.....	.....	.....	.....	.....	5½	....	5	....	5	....	6	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21.	120,000	185,000	.....	.....	.....	.....	.....	6	....	6	....	5	....	6⅛	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22.	127,500	210,000	.....	.....	.....	.....	.....	5	....	5¼	....	4¾	....	6½	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23.	.....	227,000	.....	.....	.....	.....	.....	.....	....	.....	....	7¼	....	6¾	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24.	142,500	267,000	.....	135,000	.....	225,000	.....	24	17	25	15½	21	13	21¼	12	23	13	24	9¾	24	16	24	14	.....	.....	.....	.....	3	4	4	.....	.....	.....	.....	.....	.....	.....	*c*1	.....	.....	.....
25.	105,000	285,000	180,000	Void.	.....	333,000	168,000	23½	15	25¾	12¾	23	15	25¾	13½	Void.	.....	.....	.....	24½	15	25	9½	.....	.....	.....	.....	1	1	.....	*a*Void.	.....	.....	.....	*d*1	1	.....	.....
26.	156,000	262,500	.....	157,500	96,000	30,000	.....	25	13½	26½	10¾	24	15	26	14	23½	13½	24½	10	24	15	24½	10¼	.....	.....	.....	.....	2	3	2	*h*1	.....	.....	.....	*e*3	2	.....	.....
27.	.....	.....	.....	127,500	127,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24½	16	24½	14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*b*1	..	1	3	.....	.....	.....	.....
28.	.....	Void.	.....	.....	.....	.....	.....	.....	.....	.....	.....	Void.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
29.	.....	Void.	.....	.....	.....	.....	.....	.....	.....	.....	.....	Void.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30.	No recoil	Recoil jerk 30,000	.....	.....	.....	.....	.....	5¾	....	5¾	....	3½	....	3	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
31.	No recoil	Recoil jerk 65,000	.....	.....	.....	.....	.....	4	....	3¾	....	5	....	5	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32.	Recoil jerk 10,000	65,000	.....	.....	.....	.....	.....	4	....	3¾	....	5½	*m*	No record.		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

REMARKS: Line 6—Slideometer weight jumped with tandem spring gear; line 7—After stop, with tandem spring gear, there was a very severe shock on locomotive; line 8—See notes *s* and *t*, also *(asterisk); line 9—See notes *s* and *w*; line 10—See note *s*; line 11—See note *g* and *(asterisk); line 24—See note *c*; line 25—See notes *a* and *d*; line 26—See note *e* and *h*; line 27—See note *b*; lines 28 and 29—Voided on account of sections not colliding; lines 30 and 31—See note *k*; line 32—See notes *k* and *m*.

DESCRIPTIONS OF LOCOMOTIVE AND CARS USED IN THE DEMONSTRATIONS RECORDED IN THE RECAPITULATION OF THESE TESTS.

LOCOMOTIVE.

Consolidation, Class C57 22/30 187.
Number, S. P. 2765.
Total weight, loaded, 208,000 lbs.
Weight on Drivers, 187,000 lbs.
Tractive Power at 10 M.P.H., 43,305 lbs.
Locomotive equipped with 9,000 Gal. Rectangular Tender.
Weight of Tender, loaded, 170,500 lbs.
Weight of Locomotive and Tender, loaded, 378,500 lbs.
Engine Speeds from Boyer Recorder.

CARS.

Oil Cars, Class O—50—2.
Capacity, 12,430 Gals.
Capacity, 100,000 lbs.
Light weight, 48,300 lbs.
Length over end sills, 41 ft. 10 in.
Length over couplers, 44 ft. 3¼ in.

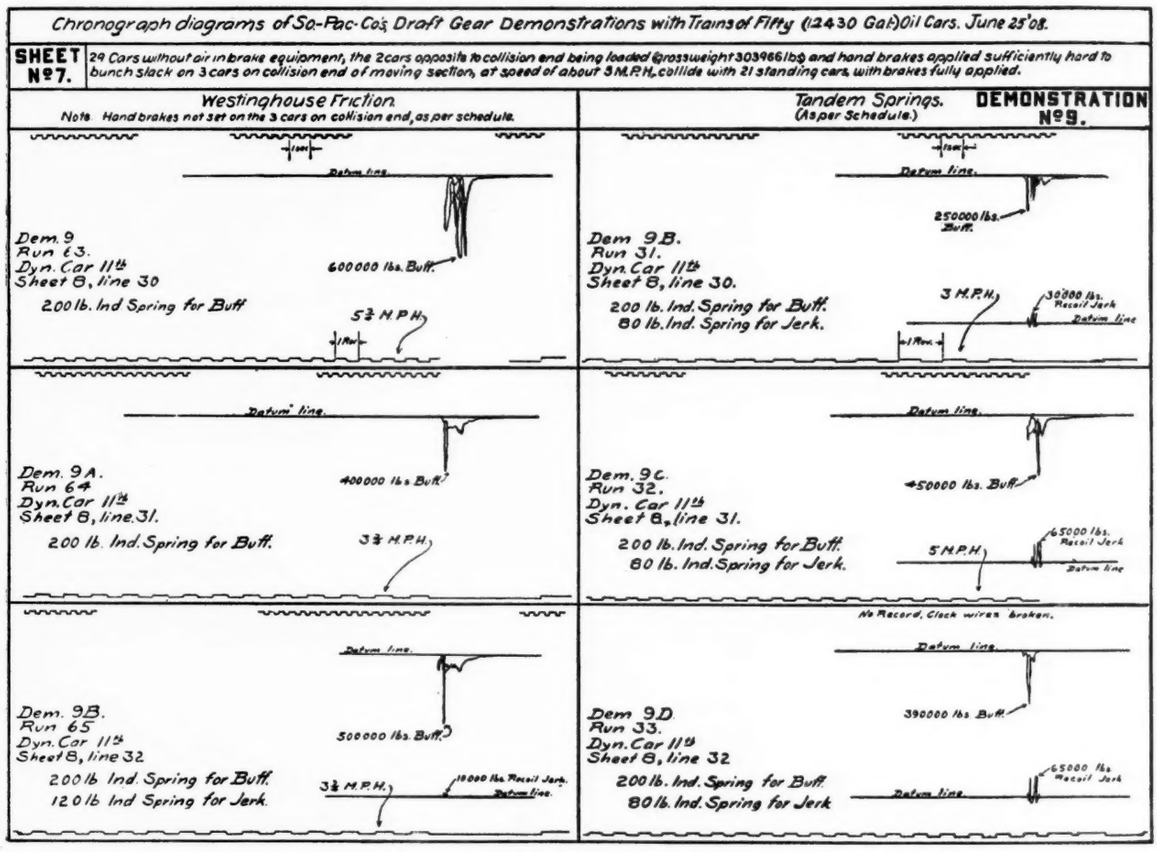
C—Denotes broken knuckles.
D— " damaged knuckle pins sheared in some cases.
E— " cracked or broken couplers.
F— " cars set out on account of coupler defects.
a—When approaching Demonstration knuckle slipped and train parted between thirty-ninth and fortieth cars.
b—Train parted between fiftieth and fifty-first cars.
c—Train parted between forty-fifth and forty-sixth cars.
d—Train parted between twenty-seventh and twenty-eighth cars.
e—Train parted between tender and first car, and between twenty-fourth and twenty-fifth cars, also renewed knuckle on second car.
f—Also three yoke rivets and one truck spring broken.
g—Also yoke rivets broken on tender coupler.
h—Train parted between thirty-sixth and thirty-seventh cars.
k—Slack not bunched with hand-brakes on three cars on collision end of moving section.
m—Clock wires broken.
s—Secondary jerk came after recoil blow. No first jerk recorded before train parted.
t—Train parted between sixth and seventh cars.
w—Train parted between tender and first car, and between twelfth and thirteenth cars.

* NOTE.—*On account of accident to train caused by brakes going into unexpected quick action while preparing for demonstrations 5 and 6 two knuckles were broken, four knuckle pins were damaged, one coupler was broken and three cars were set out on account of defective couplers.*

continued to work steam with full throttle until stalled. The dynamometer car was the forty-first car, in other words, where the jerk and recoil were most severe, and the indicator diagrams show that with Westinghouse friction gear the jerks were on the order of long, steady pulls of 43,000 to 45,000 lbs. with no recoil whatever, the train remaining intact, while with tandem spring gear there were severe jerks in quick succession from 50,000 to 80,000 lbs, which parted the train and recoil blows occurred ranging from 360,000 to 520,000 lbs. No ordinary equipment or lading could withstand such severe treatment.

Test 6 was made to determine the value of the gears in reducing shocks resulting from an emergency application of the brakes, which might be caused by hose bursting or train parting near the rear end of train similar to the condition above described, except with engine shut off and train drifting. The trains were accelerated to about 20 miles per hour and the throttle closed. After the slack was bunched an angle cock was opened at rear of train. The indicator diagrams show the jerks reduced to pulls with friction gear ranging from 45,000 to 146,000 lbs. while with tandem springs the jerks ranged from 35,000 to 265,000 lbs, the shape of the diagrams showing difference in the time element.

On sheet 4, test 7, will be seen the records of performance of the two types of draft gear under severe conditions produced by rough handling in starting heavy trains. The trains were backed at a speed of five miles per hour to represent attempting to gather slack and when the slack was all bunched the reverse lever was thrown into forward motion, throttle opened wide, and rail sanded. The dynamometer car was twenty-sixth car, except in part of the spring gear runs. It will be noted that the Westinghouse friction gear performance was almost identical in each run, showing jerks from 111,000 to 127,500 lbs., all well within its capacity, while the tandem springs show jerks from 185,000 to 305,000 lbs. under similar



Record of Test 9.

conditions, all many times the capacity of the springs and some spring gear diagrams show over 25 distinct jerks.

Probably more damage to equipment and lading has been caused by engineers running on short time attempting to release brakes on freight trains to save the time necessary to come to a full stop after slowing down than from any other one cause over which operating officials have control. To determine the value of the draft gears in such a case, in test 8 the trains were run at approximately 20 miles per hour, engine throttle closed, a 15-lb. service brake pipe reduction made (a heavy brake application), and when speed had been reduced to about eight miles per hour the brakes were released and engine throttle opened wide.

The indicator diagrams do not give all the data, since with the Westinghouse friction gear the jerks were from 105,000 to 156,000 lbs., all within its capacity, and with the tandem spring gear the jerks were from 262,500 to 285,000 lbs., all beyond their capacity, yet with the Westinghouse equipment the train remained intact and was again accelerated as intended, but in the attempts to accomplish this much desired result with the spring gear the train was parted, sometimes in several places, and in no case was the train again put under way.

It is absolutely impossible to permit engineers to make a practice of attempting to release brakes and applying steam with long freight trains under way which are equipped with spring draft gear and standard quick action triple valves.

The indicator diagrams of test 9 show performance of the gears under yard switching conditions. It will be noted that while the maximum blows recorded are very high, yet with the friction gear there was but a slight trace of recoil in one instance only, while with the tandem spring gears the recoil jerks reached 65,000 lbs.

The blows struck and recorded by the dynamometer car were for the purpose of illustrating the power of destructive shocks given cars and lading in switching, and while the moving part of the train was only going at from three to five miles per hour in these runs, yet much switching is done at higher rates of speed, and the explanation for lading and car damage in yards is not difficult to seek.

ELECTRIC RAILWAY ROLLING STOCK FOR URBAN AND SUBURBAN SERVICE.

BY H. M. HOBART, M. INST. C.E.

The weight of an electric passenger train may be divided into four parts:

I. The trucks, including truck frames, wheels and axles, brake rigging, etc.
II. Coach bodies with underframes, brake cylinders, etc.
III. Electrical equipment, including motors, rheostats, transformers, controllers, collectors, compressors, motors, cables, etc.
IV. Passengers.

For a given seating capacity, components I. and II. increase in weight slowly with increasing schedule speed and decreasing distance between stops; nevertheless representative weight and cost values may be readily assigned to these items.

Component III. increases rapidly in weight with increasing schedule speeds and with decreasing distance between stops. The weight of component III. is also very dependent upon the type of electrical equipment.

Component IV. is a very variable factor. While the number of passengers is often considerably in excess of the seating capacity, the *average* of the number of passengers carried by an urban or suburban train throughout all its journeys is rarely more than 40 per cent. of the seating capacity. In the following investigation, component IV. is not comprised in the "total train weight," which in this investigation is taken as the dead weight. This is justified by the greater simplicity with which the investigation may be carried through. The "total train weight" (TTW) is thus taken as the sum of the first three components, namely:

I. The trucks.
II. The car bodies.
III. The electrical equipment.

Let us take the case of a well built three-coach train providing 180 seats with the usual proportion of first class and third class seats, and to be operated at a schedule speed of 26 miles per hour with one stop per mile. Let the average duration of stop be 20 sec. Such a train will require an electrical equipment providing 12 rated h.p. (1 hr. 75 deg. C. basis of rating) per ton weight of train.

The following rough data of weights and costs will serve the purpose of this investigation:

Bogie trucks: Weight of each motor truck, including truck frames, wheels and axles, brake rigging, etc. ..... = 5.5 tons.
Weight of each trailing truck ..... = 4.0 "
Cost of trucks = £22($110) per ton.*
Car Bodies: Weight of each motor car body, complete with underframes, brake cylinders, etc. ..... = 15 tons.
Weight of each trailer car body ..... = 11 "
Cost of car bodies complete = £80 ($400) per ton.
Electrical Equipment: Weight of continuous current equipment ..... = 16 kg. per rated h.p.
Weight of single-phase equipment ..... = 40 kg. per rated h.p.
Cost of electrical equipment = £125 ($625) per ton.

*For simplicity, pounds Sterling are converted at $5.

Let us work out the weights of: First, a continuous current (cc) train, and, second, a single-phase (sp) train.

First.—Train with Continuous Current Equipment.—We may make the preliminary assumption that a suitable train for the required capacity and schedule will comprise two motor coaches and a trailer in between them, and that only one of the bogies on each motor coach will require to carry motors. Thus we have:

2 motor bogies	at 5.5 tons	=	11 tons.
4 trailing bogies	" 4.0 "	=	16 "
2 motor car bodies	" 15 "	=	30 "
1 trailer car body	" 11 "	=	11 "
Weight, exclusive of electrical equipment...		=	68 tons.

Let us denote by W the weight of the electrical equipment. Then, since cc equipment weighs 0.016 ton per rated h.p., and since we require 12 rated h.p. per ton of total train weight (= 68 + W), we have

$$W = 12 \times 0.016\ (68 + W) = 16 \text{ tons.}$$
$$TTW = 68 + 16 = 84 \text{ tons.}$$

Consequently rated capacity of electrical equipment = 84 × 12 = 1,000 h.p. This may be provided by four 250-h.p. motors, and auxiliary apparatus. We may estimate the cost as follows:

Trucks	= 22 x 27 =	£595($2,975)
Car bodies	= 80 x 41 =	3,280(16,400)
Electrical equipment	= 125 x 16 =	2,000(10,000)
Labor in assembling at £6($30) per ton..	=	505(2,525)
Total cost of train		£6,380($31,900)
Total cost per ton		76($380)
Total cost per seat		35($175)

Second.—Train with Single-Phase Equipment.—We shall require to provide 12 motors, one for each axle. Thus we have:

6 motor bogies	at 5.5 tons	=	33 tons.
3 motor coaches	" 15 "	=	45 "
Weight, exclusive of electrical equipment....		=	78 tons.

Denoting by W the weight of the electrical equipment, then since sp equipment weighs 0.040 ton per rated h.p., and since we require 12 rated h.p. per ton of TTW (= 78 + W), we have

$$W = 12 \times 0.040\ (78 + W) = 72 \text{ tons.}$$
$$TTW = 78 + 72 = 150 \text{ tons.}$$

Consequently rated capacity of electrical equipment = 150 × 12 = 1,800 h.p. This may be provided by twelve 150-h.p. motors and auxiliary apparatus.

The cost works out as follows:

Trucks	= 22 x 33 =	£725($3,625)
Car bodies	= 80 x 45 =	3,600($18,000)
Electrical equipment	= 125 x 72 =	9,000($45,000)
Labor in assembling at £4 per ton....	=	600($3,000)
Total cost of train		£13,925($69,625)
Total cost per ton		93($465)
Total cost per seat		77($385)

Taking maintenance and depreciation of rolling stock and

interest on the capital outlay at 15 per cent. per annum, the annual costs are respectively:

	Per annum.
With continuous current ..... =	£5.3($26.50) per seat
With single phase ..... =	11.5($57.50) per seat

In the next step we determine the miles traveled by each train per year. Each train should be in service for some

$$300 \times 15 = 4{,}500 \text{ hours per annum.}$$

During this time, at 26 m.p.h., it will cover

$$26 \times 4{,}500 = 117{,}000 \text{ miles.}$$

The input to the train will be 100 watt-hours per ton-mile. Taking the average efficiency from the generating station to the train as 80 per cent. for continuous current and 90 per cent. for single-phase, we have the output from the generating station per ton-mile:

With continuous current	= 125 watt-hours.
With single phase	= 111 watt-hours.

Or output per train-mile:

$$\text{With continuous current} = \frac{84 \times 125}{1{,}000} = 10.5 \text{ kw. hrs.}$$

$$\text{With single phase} = \frac{150 \times 111}{1{,}000} = 16.6 \text{ kw. hrs.}$$

Or output per train-year:

	Kw. hrs.
With continuous current	= 10.5 x 117,000 = 1.23 million.
With single phase	= 16.6 x 117,000 = 1.94 million.

At a price of 0.33 penny (0.66c.) per k.w. hr. delivered from the generating station, the cost of electricity per train per annum is:

$$\text{With continuous current} = \frac{1{,}230{,}000 \times 0.33}{240} = £1{,}690 (\$8{,}450)$$

$$\text{With single phase} = \frac{1{,}940{,}000}{240} = £2{,}690 (\$13{,}450)$$

Annual cost for electricity per seat:

For continuous current	= £9.4($47)
For single phase	= 14.9($74.50)

Thus the annual cost for maintenance, depreciation, electricity and interest on capital are:

With continuous current..... 5.3 + 9.4 = £14.7($73.50) per seat.
With single phase .....11.5 + 14.9 = 26.4($132) per seat.

or

$$\text{with continuous current} = \frac{14.7 \times 240}{117{,}000} = 0.030\text{d.}(0.06\text{c.}) \text{ per seat mile;}$$

or

$$\text{with single phase} = \frac{26.4 \times 240}{117{,}000} = 0.054\text{d.}(0.108\text{c.}) \text{ per seat mile.}$$

As regards other charges the characteristics of the two systems fairly offset one another. With the heavy single-phase trains, the maintenance and depreciation charges for the permanent way will be much greater than with the relatively light continuous current trains. The cost of single-phase overhead construction is greater than that of third-rail construction. These two items will offset the greater cost of the sub-station machinery in the continuous current system. Thus, for the schedule we are considering, we may assess to the single-phase system a cost of (0.054 — 0.030 =) 0.024 penny (0.048c.) per seat-mile in excess of the cost incurred when continuous current is employed. For the 180-seat train in question, this represents $0.024 \times 180 = 4.3$d. (8.6c.) more per train-mile with a single-phase than with a continuous current train.

The average fare for urban and suburban railways is around 0.6d. (1.2c.) per mile. But since a seat is, on the average, occupied for—say—40 per cent. of its journey, the receipts per seat-mile are around

$$0.6 \times 0.40 = 0.24\text{d. (0.48c.)}$$

corresponding to $180 \times 0.24 = 43$d. (86c.) per train-mile for the 180-seat train which we are considering.

Thus the 4.3d. (8.6c.) handicap of the single-phase system makes an inroad of 10 per cent. on the gross receipts, and in the case of most railways, is much more than sufficient to wipe out dividends were electrification introduced on an extensive scale. Or looking at the matter from the opposite standpoint, if, as Mr. Dawson and others have claimed, single-phase can, under these conditions, compete with steam, then the use of continuous current would render available for dividends a further 10 per cent. of the gross receipts. I have taken the high figure of an average fare of 0.6d. (1.2c.) per mile and 40 per cent. of the seats occupied, with the purpose of favoring the system in my comparison. As is well known, such favorable figures are the exception on urban and suburban railways, and in so far as lower figures are obtained, the 10 per cent. difference in favor of cc would be replaced by a higher percentage. At present none of the London Underground Railways are taking in as much as this (i.e., 0.24d., 0.48c.) per seat-mile.

It will be pointed out that the case I have taken, namely, a service in which, with one stop per mile, a schedule speed of 26 miles per hour is maintained, is rather a severe service. I am quite aware of this. But it is the very ability to provide such a service which is often a chief inducement to introduce electric operation. If still with one stop per mile, we come down to schedule speed of 22 m.p.h., while electrification is highly desirable there are not (except for mountain roads and for tunnels and elevated roads) so strong advantages in its favor as exist in the case I have taken for my example. While at the lower speed (with one stop per mile), the disparity between single-phase and continuous current is distinctly diminished, the advantage for continuous current is still far too great to be overlooked. At the slow schedule of 18 m.p.h. and one stop per mile or with any schedule equivalent to this, such as still lower speeds with more frequent stops, or higher speeds and less frequent stops (such as Heysham) we come to the range of work where, so far as relates to the rolling stock, it is more or less indifferent which system is employed. But for so unattractive a service there will rarely, with present developments, be found sufficient economic advantage to justify substituting electricity for steam.

A point which has not been sufficiently appreciated is the large percentage which the rolling stock constitutes of the total capital outlay of urban and suburban railways.

Thus take the case of 50 miles of double track, over which trains, each with a seating capacity for 450 passengers, are operated at a headway of 2½ minutes and at a speed of 14 miles per hour with two stops per mile. The distribution of the electrification and rolling stock costs is somewhat as follows:

Generating station	£800,000($4,000,000)
Transmission system.*	1,600,000(8,000,000)
Cc rolling stock	3,200,000(16,000,000)
Total	£5,600,000(28,000,000)

*Including sub-stations.

The rolling stock constitutes 57 per cent. of the total and the maintenance and depreciation thereon are enough greater than on the other items to raise the annual costs associated with the third item to some 75 per cent. of the annual costs associated with the total of the three items.

A group of calculations for 180-seat trains stopping once per mile and for various schedule speeds, yield results which I have brought together in the following table:

Schedule speed with one stop pr mile.	Weight and cost: Total train: Weight, tons. C.c.	S.p.	Total cost: C. c.	S.p.	Cost: Per ton: C.c.	S.p.	Per seat: C.c.	S.p.	Ratio.*
18 m. p. h..	73	85	£4,900	£6,400	£70	£75	£27	£35	1.29
			$24,500	$32,000	$350	$380	$135	$175	
22 " ..	77	103	5,400	8,200	72	80	30	45	1.50
			$27,000	$41,000	$360	$400	$150	$225	
26 " ..	84	150	6.400	13,900	76	93	35	77	2.20
			$32,000	$69,500	$380	$465	$175	$385	
30 " ..103	...†		8,200	.....†	80	...†	45	...†	....
			$41,000		$400		$225		

*Ratio of cost per seat for single phase train to cost per seat for continuous current train.
†Not possible with present developments.

From this table we see that the cost of a cc train for 30

m.p.h. is about equal to that of a sp train for 22 m.p.h., and that the cost of a cc train for 26 m.p.h. is about equal to that of a sp train only capable of 18 m.p.h. The table permits of realizing much more clearly the limitations and the legitimate field for single-phase traction. It is reasonable to suppose that in the course of a few years, a 20 per cent. handicap may be overcome as further experience with the single-phase system is obtained, although it must be remembered that improvements are still constantly occurring in cc equipments. But for the more severe schedules the disparity is of so great magnitude as to make it as unreasonable to delay railway electrification pending improvements in single-phase methods as it would be to stop building railways pending aviation developments.

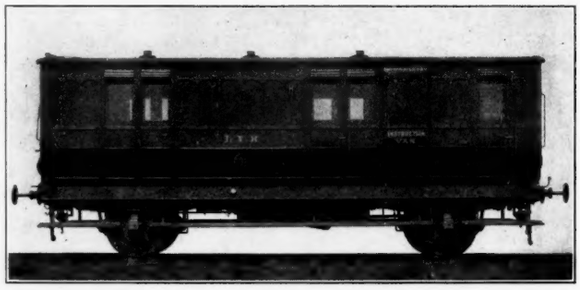
Referring again to the above table of weights and costs, it must be clearly realized that 18 m.p.h. with only one stop per mile is no longer an especially attractive service for suburban lines, and is easily performed by steam. So comparatively low a speed is only justified for runs averaging not much over one-half mile between stops. With only one stop per mile, 22 m.p.h. is the lowest schedule speed that can be considered distinctly attractive, and with our present experience the tendency will be strongly toward some 24 to 25 m.p.h., for cases where there is an average distance of one mile between stations.

INSTRUCTION CAR FOR LOCOMOTIVE MEN.

George Hughes, Chief Mechanical Engineer of the Lancashire & Yorkshire Railway, has recently equipped an instruction car as a portable lecture room. The intention is, that the car shall be sent to the various locomotive depots on the company's line, where mutual improvement classes have been formed, and lectures given by qualified persons, to the engine-drivers, firemen, mechanics, etc., with the object of thoroughly familiarizing them with all the various mechanisms they have to deal with when engaged on locomotives.

The interior of the car is fitted up with a number of seats for the audience, also lecture table, models, drawings and a small library of useful books having special reference to locomotives. The drawings are suspended from a roller fastened to the roof of the car when being used for purposes of explanation by the lecturer.

Ample facilities have been provided for having the lectures well illustrated, as will be seen by reference to the appended list of drawings, models, etc., and there is no doubt that the provision of such means of diffusing knowledge is bound to



Lancashire & Yorkshire Instruction Car.

result in the members of the locomotive staff possessing a keener intellectual grip of the machine that is placed in their charge.

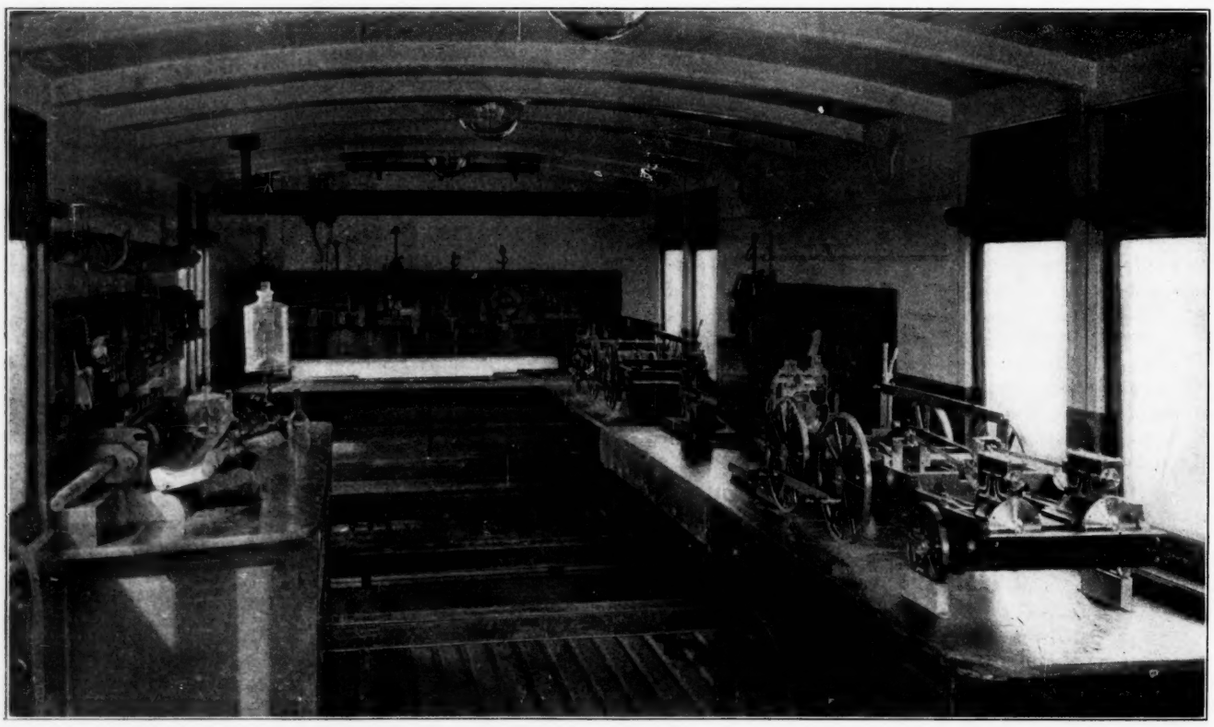
List of Drawings.

Sight feed lubricator.
Water pickup.
Slide valves
Motion.
Brake fittings.
Section of boiler and smokebox.
Radial axlebox.
Types of regulator heads.
Both types of big ends.
Sanding arrangement.
Pump ejector
Vacuum diaphragm cylinder and ball valve.
R. H. injector. L. H. injector.
Combination ejector.
Joy's Motion.

List of Models.

Joy's Motion.
Link motion.
Vacuum pump in two sections.
Section of ball valve.
Section of auxiliary valve.
Two sections of old type injector.
Section of combination injector.
Five sections of large combination injectors.
Three sections of pump type ejector.
Four sections of new type ejector.
Section of sight-feed lubricator.
Two sections vacuum brake rapid acting valve.
Vacuum brake diaphragm cylinder.
Hand vacuum pump.
One pair of weighing scales with weights.
One flash with shut-off cock.
Two bell jars.
One mercury barometer.
One glass bottle jar, and 6 flasks.

The car is also provided with a library of reference works and text books on locomotive practice.



Interior of Lancashire & Yorkshire Instruction Car.

General News Section.

The Atchison, Topeka & Santa Fe, which has for several years used telephones for block signaling, is now using them on two divisions for sending train orders; and they will soon be so used throughout the line from Chicago to Denver.

The Canadian Pacific has established an Industrial Department in the West with the object of supplying information to manufacturers, merchants and others desirous of locating in that section. The department will be under the direction of F. W. Peters, Winnipeg.

The Pennsylvania Company has asked the United States Court at Indianapolis for a restraining order to prevent the Lake Shore & South Bend Traction Company from laying a track across its right-of-way in Tolleston without first making arrangements for putting in suitable signals.

The Southern Pacific has discontinued the service of train agents (collectors of tickets and fares) on the line between El Paso and San Francisco. These collectors were dispensed with on the lines east of El Paso some time ago. Train agents have been in service on the Southern Pacific lines for the past five years.

William Vanamee, receiver of the Wallkill Transit Company, Middletown, N. Y., has issued an order that hot coffee shall be furnished free to motormen and conductors during the winter months between the hours of 6 and 9 o'clock in the morning and 6 and 12 o'clock at night; and motormen and conductors are expected to abstain entirely from the use of intoxicating liquors.

Under the profit sharing plan of the United States Steel Corporation for the year 1909 both the preferred and common stocks will be offered to employees for subscription. They can subscribe for preferred stock at 110 and common at 50. Recent market prices are about 113 for preferred and 52 for common. Heretofore, only preferred stock has been offered to employees. Last year it was offered at 87.50 and the highest previous price was 102, in 1907. Since the plan has been in force, about $12,000,000 in dividends, bonuses, etc., has been distributed to employees holding stock.

The Board of Mediation under the Erdman act, Messrs. Knapp and Neill, announces the signing in Washington of a compromise agreement between the Missouri, Kansas & Texas Railway and its employees. Enginemen, firemen, trainmen and conductors were involved. The most important point at issue concerned the computation of over-time under existing contracts as affected by the hours of service law. The Chicago tie-up agreement, so called, provides that where a crew is tied up after 14 hours it shall be deemed tied up in compliance with the law, and no overtime is allowed, but if tied up before 14 hours have expired, then time is allowed for the full time the crews are tied up. The settlement upon this point carries an agreement on the part of the company to put in force the Chicago tie-up rule on March 1, 1909. The settlement further carries the withdrawal of certain demands on the part of employees and a modification of the general principles of the Chicago agreement to suit local conditions on the M., K. & T.

E. E. Calvin, Vice-President and General Manager of the Scuthern Pacific, is quoted in the San Francisco papers as stating that the Dumbarton cut-off will be open for business on March 1, and about 90 per cent. of all the freight hauled to San Francisco by the Southern Pacific from the East and the interior valleys will then reach the city by rail around the south end of the bay, over this cut-off. The only freight sent across the bay from Oakland will be for the warehouses of the section near Lombard street pier. Eastern freight will be carried via Sacramento, Stockton, Niles and Dumbarton. Mr. Calvin said that some time ago the Southern Pacific was ferrying as many as 400 loaded freight cars to San Francisco daily, but that with the opening of the cut-off fully nine-tenths of these cars will be sent by the Dumbarton route. The freight boats from Oakland creek bridge to the foot of King street will be taken off. Mr. Calvin said that rumors about the Southern Pacific building tunnels under the city to deliver freight east of Telegraph Hill and in the neighborhood of Tenth and Market streets are baseless. He also said that a union passenger station is not under consideration.

Mayor J. N. Adam, of Buffalo, N. Y., in his annual message to the Common Council recommends that "every privilege granted to any railway for any purpose where the same does not directly serve as a switch to some Buffalo industry to whose prosperous continuance such switch is necessary, be revoked; that the roads be obliged to maintain flagmen night and day at every crossing at grade, that a commission of five be appointed to investigate assessment of railway property, that the state Public Service Commission be asked to compel the construction of improved stations; that at perilous crossings every train be stopped; that switching be forbidden at all crossings at grade, and that the legislature be asked to compel the roads to defray the entire cost of future grade crossing improvement, maintenance, consequential, and other damages." Mr. Adam's views should perhaps be accorded a standing somewhat different from that accorded the utterances of most mayors, for the reason that, as a member of special commissions, he has had many years' experience in dealing with railways and railway questions. The grade crossings of Buffalo have long been a hard problem; and the Buffalo papers have recently announced the failure of a long series of negotiations looking to the establishment of a new union passenger station.

New Cars and New Methods.

New York City is to have "pay-as-you-enter" street cars in large numbers and some of the cars are to have folding steps. The new type of cars, equipped with fare boxes on the rear platforms, will be put in operation on the Third Avenue Line on January 10. The conductors will give and receive transfers and will make change, but will not be allowed to touch the nickels, which must be deposited in the fare box by the passengers. Passengers may leave the cars at either the front or rear door. If they want transfers they must ask for them when they enter the car. The new cars will weigh seven tons less than the pay-as-you-enter cars at present in operation on the Madison avenue line of the Metropolitan. The steps fold up when the cars are in motion. The receiver for the Third Avenue Line has ordered 200 new pay-as-you-enter open cars, which also will be equipped with fare boxes. These cars will have an aisle in the center.

Change in Policy of Pennsylvania Promotions.

John S. Considine has been appointed Assistant Supervisor of the Pennsylvania at Columbia, Pa. In this appointment the Pennsylvania has broken a long-standing precedent, as Mr. Considine was a track foreman, which may be considered the highest rank of non-commissioned officers. An ordinary laborer could eventually become a track foreman, but it has not been the policy of the company to promote track foremen to a higher rank. The Pennsylvania has for years employed graduates of technical schools to be trained for promotion to the important engineering and mechanical positions. Realizing, however, that many employees who have not had the advantages of a college education, apply themselves so diligently to their work that they acquire a proficiency which should be recognized, the management has been carefully observing the work of all grades of men in the service, with a view to promoting those who showed exceptional ability, no matter what their start had been. Mr. Considine entered the service as a track laborer when but 15 years old. After five years he was assigned to duty in a supervisor's office.

There he acquired the rudiments of civil engineering. Later he was sent out on the road as track foreman, and his work in that capacity was of such a character that the title of general foreman of track laying was created for him. At this point Considine would have come to a sudden stop had it not been for the change in policy.

Our Country and Our Railroads.*

To successfully carry through important railway construction work, plans must be made years ahead; therefore, it is of paramount importance for the people and the railways to have a fixed governmental policy that can be relied upon. A policy that is changing, either through the Federal or state governments or railway commissions vested with power to arbitrarily regulate and restrict railways in their operation, prevents railways from successfully enlisting the support of bankers to enable them to plan future development, which this country must have to take care of its growing population, increasing demand for occupation, habitation, sustenance and transportation. We are beginning to live down the effects of last year's depressing conditions; but we are an advancing and forgetting people and before the recent panic has been forgotten, we should, as individuals and through co-operation, aid in influencing a governmental policy which will protect us from similar calamities in the future. The first essential factor in building a new country is the locomotive; the second, the plow; and when political agitation, unnecessary and restrictive regulations act as a bumping post to stop the headway of the locomotive, they stop the future progress and prosperity of the nation. If that vast domain west and southwest of Chicago, which is so rapidly turning its grazing lands of the past into farming lands of the future, is to have the same mileage of railway to an equal area as the country east of you, the present mileage will have to be increased by 100,000 miles of new railway. It was from that section of the country the packing houses received their grass-fattened cattle prior to the advent of the railway, while now many of the large pastures are owned by prosperous farmers who have so increased their productiveness, since the pasture days when ten acres were required to take care of one animal, that the same ten acres now produce 450 bushels of corn, 300 bushels of wheat or eight bales of cotton. This illustrates the change that is taking place and furnishes indisputable evidence that the country's transportation, unless pushed forward, will soon become inadequate, and the loss must fall upon the farmer, the merchant and the manufacturer alike. The country now needs a rest from further regulative laws until the railways can adjust themselves to a compliance with those which have been enacted.

All work necessary for the proper upbuilding of a country like ours cannot be accomplished alone through the railways. Our waterways must have the attention of the Federal government under as broad and comprehensive a plan as the policy pursued by our bankers in finding capital to build up our splendid railway systems. Compare the work of the government in furnishing water transportation where nature has provided the rivers and only awaits the work of contractors with what has been accomplished by our financiers and contractors in building our railways of 230,000 miles to an efficiency capable of moving the nation's traffic and its population. Consider what our property values and our transportation facilities would have been had the government kept pace with the country's progress with the waterways. To put it another way: If the 30,000 miles of railway of this country at the close of the war between the states had been under government ownership and control, the same as navigation or waterways, where would we have been to-day in the nation's growth if they had done no better for the public in furnishing rail transportation than they have in furnishing water transportation? Among the most important undertakings that should receive attention is the Chicago canal, which, through the Mississippi river, will connect the Great Lakes and the Gulf of Mexico. This canal completed to an efficiency to accommodate deep draught vessels will bring our cars laden with farm products of the west and manufactured goods of the east in direct connection with the ships to carry our commerce to all parts of the world. There is no reason why we should not have the work of both the Panama and the Chicago canal pushed to completion, but viewed from a cold business standpoint as a national investment the money expended within the boundaries of our own country would be worth dollars to dimes to the American people.

Railway pools should not be legalized; pools are secret understandings between the parties to them; but railways should be permitted to enter into open traffic alliances, subject to the approval of the Interstate Commerce Commission, which would safegard the interests of the public. The same Federal authority should authorize the issuance of railway securities, thereby protecting the investor against over-capitalization. The Capitol at Washington will then become the "Hague" of the nation's railways and its commerce, where peace conferences will be held to settle the questions arising between the public and the railways fair to both, and without political influence or favoritism to either.

*From an address by B. F. Yoakum before the Chicago Association of Commerce, at Chicago, December 9.

Twenty-Nine Million Dollar Fine Has Evaporated.

The United States Supreme Court on Monday last announced that it would not review the case of the Standard Oil Company, in which a fine of $29,240,000 was imposed. The decision was announced by Chief Justice Fuller very briefly, no reason being given. The government had asked for a writ of certiorari to review the decision of the United States Circuit Court of Appeals for the Seventh Circuit, by which Judge Landis' decision imposing the fine for accepting rebates from the Chicago & Alton had been reversed. In the Supreme Court the case turned largely upon the right of the court to interfere in view of the fact that the case had been passed upon by the Court of Appeals, the government contending for such privilege as a right, while it was urged in behalf of the oil company that precedents were all against such a proceeding. Under this ruling the case will now go back to Judge Landis' court for a new trial, in accordance with the decision of the Court of Appeals. This decision, by Judge Grosscup July 22, 1908, held that the trial court had erred in its rulings on the admission and exclusion of evidence and in its charge to the jury; that the offence of accepting a concession is the "transaction" that the given rate consummates, whereby the shipper, for the thing shipped, no matter how great or how little its quantity, receives a rate different from the established rate; and that the trial court abused its discretion in imposing an excessive fine.

It is expected that the United States Attorney will take action within the next few weeks. On a new trial the fine to be imposed upon the Standard Oil Company of Indiana, if it should be adjudged guilty, probably would not exceed $1,000,000.

The trial of this case was begun in May, 1906 (*Railroad Gazette* Aug. 9, 1907, page 153; *Railroad Age Gazette* July 24, 1908, page 594).

Industrial Accidents.

Between 30,000 and 35,000 workmen lose their lives in accidents in the course of their employment in this country during a year. Census reports covering the years 1900 to 1906 show that out of over 1,000,000 deaths of males, more than 9 per cent. were due to accident. A large proportion of these deaths are due to causes more or less related to the occupations of the injured persons. Accidents fall into five general groups, viz., factories and workshops, electrical industries, mines and quarries, transportation by rail, and transportation by water. Among nut and bolt workers in Pennsylvania the returns of the chief factory inspector show the fatal accident rate during ten years to have been 5.4 per 1,000, and in miscellaneous steel and iron work 4.3 per 1,000. According to the industrial insurance experience the fatal accident rate of electricians and of electric linemen is excessive. Of 645 deaths of electricians 14.7 per cent., and of 240 deaths of linemen 46.7 per cent. were due to accidents.

In the anthracite mines of Pennsylvania the state inspectors have found that during ten years there have averaged annually 3.18 fatal accidents for every 1,000 men employed,

and the rate is even higher than this for certain specific occupations in the mines. That this is excessive is shown by comparison with the death rate from accident of 1.29 per 1,000 in the British coal mines. The reports of the Interstate Commerce Commission have shown that during ten years 16,363 railway trainmen lost their lives in accidents. This is equivalent to 7.46 deaths per 1,000 employees. Of 505 deaths of sailors occurring in the experience of an industrial insurance company 17.6 per cent. were due to accidents.

The possibilities for successful accident prevention have been clearly demonstrated in the experience of foreign countries. Granting that the underlying conditions in European countries are often quite different, and that many of our industrial accidents may be the result of ignorance, reckless indifference or carelessness, the fact remains that an immense amount of human life is wasted. If the accident liability of employees in coal mines in the United States were reduced from 3.10 per 1,000 to 1.29 per 1,000, the annual saving in human life would be 915. If the rate of casualties of railway employees in this country were reduced from 2.50 per 1,000, which was the average annual rate for 1897-1906, to 0.98 per 1,000, the average for the German Empire for the same period, the annual saving would be 1,735 valuable human lives.—*Bulletin 78, Department of Commerce and Labor.*

Catskill Water Supply Plans.

John A. Bensel, head of the New York City Board of Water Supply, says that the work of locating a tunnel for the Catskill water project under the Hudson river has been suspended, and that he is becoming more and more favorably inclined toward the bridging of the river instead. Such a bridge would do for automobiles and trolley cars, as well as the aqueduct, and the tolls collected might be sufficient to pay the interest charges on the additional expenditure. In any event, he said, the tunnel might take from four to five years to build, and it would not be known definitely until the last six months whether it was likely to prove a success.

The Age of Enterprise.

—*From Puck.*

The Imaginary Dangers of Color Blindness.

The practical application of the results of investigations in this field has come up for discussion in recent years. The æsthetician and the painter have interested themselves in these as in other visual problems. But the most natural direction in which to turn to find a practical application has proved to be toward the field of railroad signaling. In developing means of control over railroad trains, a complex system of signaling has been evolved. Here, as in the marine service, colored lights are employed for night signaling. A superficial consideration of certain defects of color vision has inspired the fear that this method of signaling is a menace to public safety. It is to be noted, however, that the objector has brought forward no evidence to show that his objection has any other than a purely fictitious foundation. Nor is it difficult to determine that the alarming conditions which he has conjured up have no counterpart in the practical affairs of railroad operation. Railroads, the world over, make use of colored signals; and the governments of several countries publish statistical reports of the numbers, the fatalities and the causes of wrecks. Now, such a country as England furnishes ideal conditions for a crucial test of the efficiency of the present system of signaling, because the English railroads have to cope with an unusual combination of adverse conditions of operation—congestion of traffic, high speed of trains, and the prevalence of fogs. Yet the English roads are noted for the infrequency of their accidents. . Their fatalities have averaged so low as one per 169,000,000 of passengers carried; and a full year has elapsed without a single fatality [to passengers from train accidents]. These data refer to accidents from all causes; and a commission recently appointed by the Royal Society reports that no accident, railroad or marine, can be traced to anomalous conditions of color vision. Practical experience then shows that colored lights constitute a safe means of signaling, and that their results are in the highest degree successful even when the conditions of operation are relatively unfavorable. Is it not clear that if railroad disasters are more frequent in America the cause is to be sought elsewhere than in a defective system of signaling? —From a paper on Color Blindness, by Prof. J. W. Baird, University of Illinois, in the *Psychological Bulletin.*

The Strang Motor Car on the Alton.

The Chicago & Alton and the Clover Leaf have been conducting a series of tests with the all-steel Strang gas-electric car "Irene" with a view to determining its efficiency for branch line service. This car was described in detail in The *Railway Age* of April 17, 1908, page 568.

On January 3, a party of railway officers, including General Traffic Manager Ross of the Alton-Clover Leaf; General Passenger Agent J. Charlton, and others made a trial run from Chicago to Bloomington, 127 miles. No attempt was made to make a speed record during the trip, and including the time consumed in stops, an average speed of 32 miles an hour was made. During the several test trips thus far made by the Alton the operation of the car has been satisfactory, but in order to further test its efficiency the "Irene" has been put in service between Bloomington and Dwight, Ill., a distance of 53 miles, where it will make two round trips daily. If after a service of 30 days it is found satisfactory for short runs and economical enough to compete with electric interurban lines, it is probable that a number of these cars will be ordered.

Why Not?

The Tree Planting Association of New York City, Charles R. Lamb, Secretary, suggests planting trees on either side of a railway track throughout an entire right of way; this to provide the timber needed for ties and for the beautification of the railway. The suggestion is being offered to the Pennsylvania, the New York Central, the Erie and other railways. Mr. Lamb makes additional suggestions as to the co-operation of the Tree Planting Association with the local authorities of each city and town, and with the civic associations interested in the beautification of their cities or towns, so that the tree planting would be developed from the railway tracks

around the stations and on the main streets or the roads leading to the stations. The inevitable result, in Mr. Lamb's judgment, would be that the principle of tree planting would be developed in each community as its beauty, practicability and economy of administration became appreciated.

Railways and Public Opinion.

The railway, as a corporation, has no voice in the selection of those who frame and administer the laws for its regulation. Its physical property—extending in part through sparsely settled sections and through wildernesses, perhaps—is the most defenseless property that exists. In the very nature of its existence, therefore, it can find safety only when, in the darkness of the night watches, in times of stress and peril, and in the enactment of laws for its regulation, the invisible sentinel of public opinion stands guard over its rights and property.—*W. W. Finley.*

President Butler on the Sherman Law.

"It is within the truth and not too harsh to say that the Sherman anti-trust act was passed partly in ignorance and partly in a spirit of flippancy for the purpose of satisfying, or at least quieting, the demand that something be done to curb the trusts. So long as it stands upon the statute books in its present form this law is a menace to the business of the country, and it does not serve any supreme public interest which justifies it in being such a menace. It unduly exalts the principle of competition, and it fails to lay proper emphasis upon the public benefits which may follow from properly regulated and supervised co-operation.

"The public interest now urgently demands the amendment of this act in order to relieve not the corporations but the people themselves from the limitations upon their business activity which this act imposes unnecessarily and unwisely."—*Nicholas Murray Butler.*

Railway Business Association.

The work toward creating conservative railway legislation, as undertaken by the Railway Business Association, is finding its reflex in the actions of commercial bodies. The resolutions passed by the Southern Commercial Congress on December 8 are noteworthy; also those of the New York Board of Trade and Transportation on December 9, and a resolution which was adopted on December 21 by the executive committee of the Merchants' Association of New York. This association has a resident membership of 1,200 and a non-resident membership of 35,000. The Railway Business Association has requested business organizations throughout the country to take similar action, and urges manufacturers of railway materials and equipment to second actively the passage of such resolutions in communities where their manufacturing plants are located. The Merchants' Association of New York points out that the railways of the United States constitute, collectively, the largest purchasing and consuming interest in the country, and as such they have exercised a corresponding influence on all industries upon which they rely for the vast volume of material and supplies, for construction, maintenance and operation, and since the purchasing ability of the railways, especially when relating to new construction, is largely contingent upon their ability to make such new issues of security as may properly be needed to cover their financial requirements, and since the ability to do this is directly dependent, in turn, upon public confidence in the stability of the conditions which determine the earning power of the railways, these resolutions urge all members of Congress and of the legislatures of New York and other states and of railway commissions, to encourage the return of railway business to normal conditions by ceasing and discountenancing ill-considered or unjustified censure of existing railway management, and by limiting the proposed legislation to such measures as have been so carefully investigated, as to determine not only the necessity for their enactment, but also their proper form and their effect. It was also resolved that copies of these resolutions be sent to Senators and Representatives in Congress and to Senators and Assemblymen in the New York state legislature.

On December 29, the directors of the Detroit Board of Commerce adopted a resolution expressing the attitude of that organization toward railway legislation as follows: That it is the sense of this board that state and national legislatures, in view of the immediate necessity for stable conditions of finance and business, should exercise moderation and calmness in legislation affecting public service and other business corporations. The action on the part of the Detroit Board of Commerce is especially noteworahy, since it was the result of a written communication from the Railway Business Association and was not influenced in any way by personal action or contact of any member of the association, as has been the case with other resolutions which have been passed.

MEETINGS AND CONVENTIONS.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass.; May 11-14, 1909; Richmond, Va.
American Institute of Electrical Engineers.—R. W. Pope, 33 West 39th St., New York; second Friday in month; New York.
American Railway Association.—W. F. Allen, 24 Park Pl., New York; May 19, 1909; New York.
American Railway Bridge and Building Association.—S. F. Patterson, B. & M., Concord, N. H.; Oct. 19, 1909; Jacksonville, Fla.
American Railway Engineering and Maint. of Way Assoc.—E. H. Fritch, Monadnock Bldg., Chicago; March 16-18, 1909; Chicago.
American Railway Master Mechanics' Association.—J. W. Taylor, Old Colony Bldg., Chicago; June 16-18, 1909; Atlantic City.
American Society of Civil Engineers.—C. W. Hunt, 220 W. 57th St., N. Y.; 1st and 3d Wed., except July and Aug.; New York.
American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 39th St., New York; Jan. 12, 1909; New York.
American Street and Interurban Railway Association.—B. V. Swenson, 29 W. 39th St., New York.
Association of American Railway Accounting Officers.—C. G. Phillips, 143 Dearborn St., Chicago; April 28, 1909; Cincinnati.
Association of Railway Claim Agents.—C. L. Young, C. & N.-W. Ry., Chicago, Ill.; May, 1909; Detroit, Mich.
Association of Railway Telegraph Superintendents.—P. W. Drew, Wisconsin Central Ry., Chicago; June 23-25, 1909; Detroit.
Association of Transportation and Car Accounting Officers.—G. P. Conard, 24 Park Pl., New York; June 22-23; Montreal.
Canadian Railway Club.—James Powell, Grand Trunk Ry., Montreal, Que.; 1st Tues. in month, except June, July and Aug.; Montreal.
Canadian Society of Civil Engineers.—Clement H. McLeod, Montreal, Que.; irregular, usually weekly; Montreal.
Central Railway Club.—H. D. Vought, 95 Liberty St., New York; 2d Friday in January, March, May, Sept. and Nov.; Buffalo.
Freight Claim Association.—Warren P. Taylor, Rich., Fred. & Pot. R.R., Richmond, Va.; June 16, 1909; Old Point Comfort, Va.
International Master Boiler Makers' Association.—Harry D. Vought, 62 Liberty St., New York; May, 1909; Louisville, Ky.
International Railway Fuel Association.—D. B. Sebastian, La Salle St. Station, Chicago; June, 1909.
Iowa Railway Club.—W. B. Harrison, Union Station, Des Moines, Iowa; 2d Friday in month, except July and August; Des Moines.
Master Car Builders' Association.—J. W. Taylor, Old Colony Bldg., Chicago; June 21-23, 1909; Atlantic City.
New England Railroad Club.—G. H. Frazier, 10 Oliver St., Boston, Mass.; 2d Tues. in month, ex. June, July, Aug. and Sept.; Boston.
New York Railroad Club.—H. D. Vought, 95 Liberty St., New York; 3d Friday in month, except June, July and August; New York.
North-West Railway Club.—T. W. Flannagan, Soo Line, Minn.; 1st Tues. after 2d Mon., ex. June, July, Aug.; St. Paul and Minn.
Railway Club of Pittsburgh.—J. D. Conway, Pittsburgh, Pa.; 4th Friday in month, except June, July and August; Pittsburgh.
Railway Signal Association.—C. C. Rosenberg, 12 North Linden St., Bethlehem, Pa.; March 15, 1909; Chicago.
Roadmasters' and Maintenance of Way Association.—Walter E. Emery, P. & P. U. Ry., Peoria, Ill.; Nov., 1909; Washington.
St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.; 2d Friday in month, except June, July and Aug.; St. Louis.
Southern and Southwestern Ry. Club.—A. J. Merrill, Prudential Bldg., Atlanta; 3d Thurs. Jan., April, Aug. and Nov.; Atlanta.
Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R. R.R., East Buffalo, N. Y.; September, 1909; Denver.
Western Railway Club.—J. W. Taylor, Old Colony Bldg., Chicago; 3d Tuesday each month, except June, July and August; Chicago.
Western Society of Engineers.—J. H. Warder, Monadnock Bldg., Chicago; 1st Wednesday, except July and August; Chicago.

Central Railway Club.

The annual meeting, followed by a banquet, will be held at the Hotel Iroquois, Buffalo, N. Y., on January 8.

Cecil Lightfoot, Chief Engineer and Manager of the Linde Air Process Co., will present a paper and give a practical demonstration of what is done with the company's process. At the banquet O. P. Letchworth, President of the Pratt & Letchworth Co., will be toastmaster. The speakers will include W. J. Harahan, Assistant to the President of the Erie; C. F. Moore, of the West Virginia Pulp & Paper Co.; Herbert P. Bissell, Vice-President of the Great Gorge Railway; George Ham, of the Canadian Pacific, and Eugene Chamberlin, Chairman Freight Car Equipment Pool, New York Central Lines.

American Society of Civil Engineers.

The fifty-sixth annual meeting will be held on January 20 and 21, 1909, in New York. At the first morning session, annual reports and an amendment to the constitution will be presented, officers elected and committees will report on the status of the metric system in the United States, and other matters. In the afternoon, the Blackwell's Island and the Williamsburg bridges will be visited, and in the evening the President will hold a reception. On the following day, the members of the association will visit the Ashokan reservoir, a special train having been chartered on the West Shore. In the evening there will be an informal smoker.

At the regular meeting on January 6 a paper entitled "Electric Railways in the Ohio Valley between Steubenville, Ohio, and Vanport, Pa.," by George B. Francis, M. Am. Soc. C. E., was presented for discussion, and illustrated with lantern slides. This paper was printed in "Proceedings" for November, 1908.

Traffic News.

The United Fruit Co. announces that henceforth steamers will leave New York for Central American ports every two weeks (Saturdays, January 9 and 23, and February 6 and 20).

The Wabash has given notice that shippers will be allowed to use indefinitely, in connection with the new uniform bill of lading, the drayage tickets which they now have on hand.

The Chairman of the Trunk Line Association has announced that old forms of bills of lading may be used until the end of February, if stamped with the proper notations. The Southern Railway has announced that owing to unavoidable delays, the new uniform bill of lading will not be put in use on that road until February 1.

The Illinois Central and the Nashville, Chattanooga & St. Louis have established a fast freight service that will enable shipments from Chicago to reach Atlanta in about 50 hours. The time heretofore taken has been 58 to 60 hours. A proportionate saving in time will also be made to Macon, Augusta and other points beyond Atlanta. The average time made by the trains in the new service is 17 miles an hour, including stops.

The State Corporation Commission of Oklahoma proposes to adopt a uniform bill of lading, and a meeting was held on January 5 to hear any railway which might wish to remonstrate. With the notice of the meeting there was a proposed form of a bill of lading which contained none of the usual conditions, but with a clause on the face of the bill to the effect that the carrier is "subject to such liability as is imposed by law."

A federal grand jury at Chicago continued this week to investigate the relations between shippers and the claim departments of railways for evidence that the roads have been paying rebates in the form of damage claims. Representatives of the claim departments of the Burlington, the Lake Shore, the Central of New Jersey, and other roads have been before the jury, but everybody except the government lawyers continues in the dark as to just whom and what the government is aiming at.

A correspondent of the New York *Evening Post*, writing from San Francisco concerning the complaints of the merchants of California against the railways on account of their proposed increase in trans-continental freight rates, says that the steamships running in connection with the railway across the Isthmus of Tehuantepec now deliver freight in San Francisco in 27 days from New York, and sometimes in 23 days, or in practically as good time as that given by the railways; and at lower rates. Business by the Tehuantepec route is increasing; freight is delivered in good condition. The ships of the fleet are from 10,000 to 12,000 tons each, and the service is quicker and better than by the Panama route. The volume of traffic coming by way of Panama has dwindled greatly. It seems that the rates by the Tehuantepec route are adjusted so as to compete with the railways on shipments to points some distance inland from the coast in California. As the Tehuantepec route is considerably shorter than that by way of Panama, its proprietors hope to retain a good share of the business, even after the Panama canal shall have been opened.

Statistics compiled by the secretary of the Chicago Board of Trade show that the railways entering Chicago hauled to that city from the West during 1908, 9,496,037 bbls. of flour; 21,168,442 bush. of wheat; 91,169,147 bush. of corn; 92,522,017 bush. of oats, and 23,696,615 bush. of barley. The largest amount of flour, 2,170,000 bbls., was hauled by the St. Paul, and the Burlington was second with 1,500,000 bbls. The Burlington hauled 4,200,000 bush. of wheat and the St. Paul was second with 2,893,000 bush. The Illinois Central hauled 21,700,000 bush. of corn, the Burlington was second with 14,482,000 bush., and the North Western was third with 10,630,000 bush. The North Western hauled 19,887,000 bush. of oats, the St. Paul 18,133,000 bush., and the Santa Fe 15,585,000 bush. The St. Paul hauled 665,000 bush. of rye and the North Western was second with 405,000 bush. The St. Paul hauled 10,213,000 bush. of barley and the North Western was second with 7,200,000 bush.

Court and counsel in the cases involving the validity of the Missouri maximum freight and 2-cent passenger fare laws made an arrangement under which the taking of testimony was finished on December 30. By stipulation the Chicago, Milwaukee & St. Paul, the St. Louis Southwestern, the Missouri Pacific and the Iron Mountain, will abide by the decision in the St. Louis & San Francisco case; the Wabash and the Chicago & Alton will abide by the decision in the Chicago, Burlington & Quincy case; and the Chicago Great Western will abide by the decision in the St. Joseph & Grand Island case. The case of the St. Louis & San Francisco was tried in the most detail. The railways presented facts as to expenses and earnings, tending to show that the Frisco, the Santa Fe, the Rock Island, the Kansas City Southern, the St. Louis & Hannibal, the Missouri, Kansas & Texas, the Chicago & Alton, the Chicago Great Western and the Burlington, lost money on intrastate business.

Judge McPherson announced that January 13 had been agreed upon as the date for arguments to begin. Herbert S. Hadley, Attorney-General of the state, will be inaugurated governor of Missouri on January 11, and will therefore be governor when he makes the principal argument for the state in this case.

The Staten Island Rapid Transit Company, which hitherto has carried school children short distances to and from St. George at $2 a month, has announced that the rate will be raised to $6.25 a month. Over 200 pupils are affected, and on the allegation that many of these will be deprived of high school privileges because of inability to pay the high rate and at the request of the New York State Public Service Commission, First District, the road has postponed the change for a month. The Interstate Commerce Commission has decided that the granting of reduced rates to pupils of schools is illegal, as being a discrimination against other persons who do not attend school; while the Public Service Commission of the state of New York, Second District, has decided that reductions made specially for pupils of schools are eminently just and proper. According to the newspapers, the reason given by the Staten Island Rapid Transit Co. for the increase which is now announced is that the rule prescribed by the Interstate Commerce Commission must govern, though it seems that the pupils who go to St. George begin and end their journeys wholly within the state of New York.

Commenting on the agitation against higher freight rates from California, E. P. Ripley, President of the Atchison, Topeka & Santa Fe, says that the present rates between the Pacific coast and the East are the lowest freight rates in the world. The coast shippers are a favored class who get abnormally low rates because of their location, and they would not have a leg to stand on, before any tribunal, either for lower rates or to prevent an advance. Referring to the statement that the increases would add $10,000,000 a year to the earnings of the railways, Mr. Ripley said he would venture the assertion that the advances would not come to one-fourth of that sum. Mr. Ripley is quoted further as saying:

"If any people of the universe should have no complaints to

make about freight rates, it is the people of the Pacific coast. I would certainly favor equalizations in favor of the interior if the coast cities are going to raise objections to these advances. What reason exists for insisting that of all industries railways should always be held to the commercial or political grindstone? What merchant or manufacturer would be content with as little a margin of profit as the railways now get?"

The Supreme Court of the United States on January 4 affirmed the decision of the United States Circuit Court for the northern district of Illinois in the case in which the Chicago & Alton was fined $40,000 and John N. Faithorn, then Vice-President of this road, and Fred A. Wann, then its General Freight Agent, were fined $10,000 each for giving rebates to the Schwarzschild & Sulzberger Company, packers, at Kansas City. Four members of the Supreme Court voted to affirm the decision of the lower court, four voted to reverse, and Justice Moody, who started the prosecution of the case when Attorney-General, did not take part. Under the rules of the court, those voting to sustain the lower court prevailed. The Schwarzschild & Sulzberger Company has a private track to its plant at Kansas City. The Alton gave it an allowance of $1 a car on shipments of packing house products over that road to eastern points. It was contended that this was not a rebate, but a fair payment for the use by the railway of the packing company's track. The decision seems to establish that in law the payment was a rebate, but owing to the peculiar decision of the Court there is some doubt as to what the result might be if another case involving the legality of payments for the use of industrial tracks were to come before it. While the Alton claimed that in this case the transaction was legitimate, the jury found that the private tracks were mere facilities of the packing plant, and not subject to the use of the railway in discharging its duties to the general public. The company and its officers were, therefore, found guilty of granting illegal rebates. The Circuit Court of Appeals for the Seventh Circuit sustained that verdict and the Supreme Court has now in turn affirmed it.

STATE COMMISSIONS.

The Iowa Railroad Commission on December 30 rendered a decision that when freight is shipped from a point outside of Iowa to a point in Iowa and is then rebilled and reshipped to another point within the state the full state rate must be paid on the intrastate part of the transaction. The Commission had always previously ruled that in such a case the interstate through rate would apply on the entire transaction. It changed its view to conform to the decision rendered by the Supreme Court of the United States in the case of the Gulf, Colorado & Santa Fe v. Texas.

I. C. C. Answer on Northwestern Lumber Rates.

Luther M. Walter, Attorney for the Interstate Commerce Commission, has filed in the United States Circuit Court at St. Paul a demurrer and answer to the complaint of the railways attacking the decisions of the Commission in the northwestern lumber rate cases. It is denied that the rates fixed by the Commission are unreasonable within the meaning of the fifth amendment to the Federal constitution, and it is contended that the court cannot inquire as to whether said rates are just and reasonable within any other meaning; which raises directly the question whether the courts may set aside orders of the Commission upon any ground except that they are confiscatory.

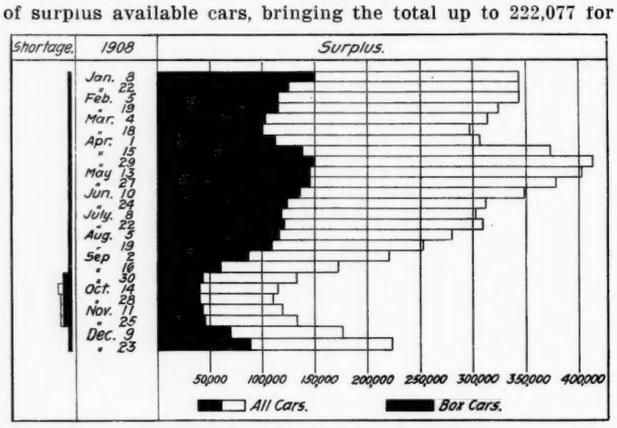
Continuing, the answer sets up that "the Commission is vested with the exclusive right and power of determining what are just and reasonable maximum rates, and that the reasonableness of such rates is not open to judicial inquiry upon original evidence leading to an independent conclusion; that in determining what are just and reasonable maximum rates to be charged in the future, the Commission must and does exercise discretion; that this court ought not and cannot substitute its judgment and discretion for the judgment and discretion of this defendant; that this court will only determine whether the rates prescribed by the Commission are just and reasonable within the meaning of the Constitutional guaranty which compels the establishment of rates with reasonable regard for the cost to the carrier of the service rendered and for the value of the property employed therein and also with reasonable regard for the value of the service to the public.

"In hearing the lumber rate cases each and every member of the Commission fully realized the great importance of the issues involved and each gave personal attention to all the testimony offered upon either side; and afterwards heard all parties at great length in oral argument; and the orders complained of are the result of the most painstaking consideration and care on the part of each commissioner."

Car Surpluses and Shortages.

Arthur Hale, Chairman of the Committee on Car Efficiency of the American Railway Association, in presenting bulletin No. 37-A, giving a summary of car surpluses and shortages by groups from December 24, 1907, to December 23, 1908, says.

"There has been a further increase of 46,434 in the number of surplus available cars, bringing the total up to 222,077 for the date of this report. Of this increase, 19,800 are box and 20,779 coal and gondola cars. The number of bad order cars continues to grow less, the decrease for this period being 2,500 cars."



Car Surpluses and Shortages in 1908.

The accompanying table shows the surpluses and shortages for the period covered by the report and the chart shows the surpluses and shortages in 1908.

Car Surpluses and Shortages, from December 24, 1907, to December 23, 1908, Inclusive.

Date.	Number of roads.	Surpluses. Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.	Shortages Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.
December 23, 1908	158	87,350	16,247	79,595	38,885	222,077	471	42	289	217	1,019
December 9, 1908	161	67,550	15,336	58,816	33,941	175,643	1,134	73	276	196	1,679
November 25, 1908	160	45,194	12,157	43,854	31,624	132,829	7,923	178	900	209	9,210
October 28, 1908	158	39,383	10,185	31,541	29,803	110,912	8,175	167	2,261	236	10,839
September 30, 1908	160	42,593	10,365	49,795	31,039	133,792	7,313	450	224	127	8,114
August 19, 1908	160	106,367	13,494	92,500	40,642	253,003	465	90	105	194	854
July 22, 1908	166	120,580	14,401	125,739	47,960	308,680	115	37	330	27	509
June 24, 1908	163	123,112	18,042	130,149	41,995	313,298	266	34	120	31	451
May 27, 1908	160	144,697	20,075	162,695	54,437	381,904	82	13	12	18	125
April 29, 1908	159	147,971	24,350	186,742	59,542	413,605	145	42	16	64	267
March 18, 1908	160	103,509	25,122	119,205	49,206	297,042	533	151	250	73	1,007
February 19, 1908	161	113,776	30,088	134,217	44,432	322,513	697	141	249	162	1,249
January 22, 1908	161	124,622	27,328	142,388	48,292	342,580	392	132	79	135	738
December 24, 1907	158	87,714	14,740	64,556	42,300	209,310	187	81	191	265	724

REVENUES AND EXPENSES OF RAILWAYS.

MONTH OF NOVEMBER, 1908.

Name of road.	Mileage operated at end of period.	Operating revenues			Operating expenses						Net operating revenues (or deficit).	Outside operations. net.	Taxes.	Operating income (or loss).	Increase (or dec.) comp. with last year.
		Freight.	Passenger.	Total, inc. misc.	Maintenance: Way and structures.	Maintenance: Of equipment.	Traffic.	Transportation.	General.	Total.					
Atchison, Topeka & Santa Fe	7,459	$4,699,834	$1,446,272	$6,638,401	$757,867	$1,204,634	$133,528	$1,780,867	$124,854	$4,001,750	$2,636,651	.....	$42,328	$2,594,323	$1,001,757
Atlanta, Birmingham & Atlantic	642	130,551	36,731	180,803	24,542	32,755	8,899	74,353	7,824	148,373	32,430	.....	7,500	24,930	12,167
Atlantic Coast Line	4,407	1,652,626	438,759	2,247,222	299,971	284,296	35,622	719,524	56,659	1,396,072	851,150	.....	90,000	761,150	150,002
Bessemer & Lake Erie	201	457,914	21,063	484,066	45,570	87,947	5,056	141,981	7,343	287,897	196,169	.....	4,000	192,169	†36,691
Buffalo & Susquehanna	373	169,654	15,128	191,278	33,763	48,707	2,268	77,028	6,360	168,126	23,152	$154*	4,000	18,998	†20,750
Central New England	294	219,361	24,888	256,523	32,190	19,421	1,618	80,659	2,827	136,715	119,808	.....	5,600	114,208	34,003
Central of Georgia	1,916	688,554	226,955	1,008,064	133,229	177,465	27,232	301,817	38,329	678,072	329,993	5,646	36,300	299,339	25,153
Chesapeake & Ohio	1,896	1,699,198	338,276	2,118,133	246,073	398,676	36,054	622,336	39,683	1,342,822	775,311	2,986*	67,100	705,225	†25,656
Chicago & Alton	998	661,374	292,261	1,036,841	111,303	129,213	33,395	357,361	28,293	660,065	376,776	1,900	30,000	348,676	103,029
Chicago & East. Illinois	566	725,996	137,808	920,783	99,857	176,295	16,952	318,698	35,518	647,320	273,464	1,617*	2,557	269,290	†41,227
Chicago & Erie	270	255,620	57,590	340,660	34,217	86,132	11,973	175,761	7,833	315,916	24,744	27	11,083	13,688	57,609
Chicago & North Western	7,635	3,910,840	1,304,837	5,654,874	610,362	621,820	88,466	2,143,475	85,924	3,550,047	2,104,827	2,497*	230,000	1,872,330	340,990
Chicago, Lake Shore & Eastern	580	305,269	.....	338,605	26,509	70,257	1,325	105,883	5,596	209,570	129,035	.....	3,000	126,035	21,963
Chicago, Rock Island & Pacific	7,423	3,195,510	1,268,912	4,754,024	780,506	621,613	111,727	1,872,021	127,527	3,513,394	1,240,630	14,796*	198,154	1,027,680	†14,453
Chicago, St. Paul, Minn. & Omaha	1,730	762,603	357,997	1,202,969	99,357	118,974	24,119	428,154	24,744	695,348	507,621	1,484*	52,970	453,167	73,347
Delaware, Lackawanna & Western	893	2,362,280	500,602	3,058,999	238,833	358,815	47,812	796,061	70,731	1,512,252	1,546,747	52,164	82,800	1,516,111	413,123
Duluth, Missabe & Northern	273	656,783	31,456	693,033	110,541	74,572	1,401	125,199	7,040	318,754	374,279	8,189	28,870	353,599	†398,848
Elgin, Joliet & Eastern	239	198,815	80	205,086	24,269	33,218	2,500	66,015	6,627	132,629	72,457	.....	9,500	62,957	†18,101
El Paso & Southwestern	867	519,979	79,630	626,122	64,805	76,814	8,526	163,170	19,258	332,573	293,549	.....	11,186	282,363	159,195
Erie	1,902	2,822,013	599,385	3,684,317	387,237	814,531	78,696	1,314,612	73,397	2,668,473	1,015,844	37,239	105,994	947,089	451,229
Grand Rapids & Indiana	590	242,245	110,410	384,909	38,558	51,669	9,462	158,227	13,057	270,973	113,936	38*	21,832	92,066	†2,430
Great Northern	6,851	4,465,808	910,638	5,673,562	518,060	569,980	53,086	1,300,253	92,397	2,533,776	3,139,786	9,208	214,463	2,934 31	679,803
Gulf, Colorado & Santa Fe	1,518	1,032,076	272,262	1,354,397	184,266	208,912	19,415	417,293	31,803	861,689	492,708	.....	15,744	476,964	326,189
Illinois Central	4,519	3,315,179	865,766	4,773,431	537,202	850,073	99,615	1,574,347	123,853	3,185,090	1,588,341	6,707*	189,716	1,391,918	112,173
Kansas City Southern	827	595,803	107,745	752,720	75,968	89,420	21,996	236,961	26,779	451,124	301,596	.....	28,330	273,266	51,168
Louisville & Nashville	4,365	2,819,985	789,221	3,863,382	447,973	692,543	79,946	1,257,228	72,853	2,550,543	1,312,839	15,815*	112,337	1,184,687	563,201
Maine Central	931	415,835	193,475	654,307	97,226	100,011	6,098	239,626	19,949	462,910	191,397	2,333	30,075	163,655	†62,766
Mobile, Jackson & Kansas City	402	120,563	25,916	155,016	20,974	16,298	1,733	44,022	8,511	91,537	63,479	.....	3,087	60,392	34,354
New York, New Haven & Hartford	2,004	2,288,352	1,885,188	4,611,179	550,009	605,852	26,130	1,922,284	85,471	3,189,746	1,421,433	118,111	284,454	1,255,091	†210,604
Norfolk & Western	1,921	2,065,087	261,404	2,411,207	239,348	386,254	40,649	720,646	54,073	1,440,970	970,237	403*	82,300	887,534	59,649
Northern Pacific	5,649	4,707,996	1,368,163	6,418,352	511,452	683,842	59,904	1,777,085	82,188	3,114,471	3,303,881	19,189	288,826	3,034,244	48,721
St. Louis & San Francisco	4,727	2,112,606	731,192	3,080,091	545,104	463,429	63,443	1,056,916	103,071	2,231,963	848,128	.....	148,427	699,701	†83,288
St. Louis, Brownsville & Mexico	456	66,508	28,425	101,822	17,884	11,151	2,670	39,122	6,844	77,671	24,151	1*	3,000	21,150	4,966
Toledo, St. Louis & Western	451	244,574	36,666	301,898	35,696	34,921	6,954	99,092	7,742	184,405	117,493	.....	11,500	105,993	†30,829
Wisconsin Central	1,023	424,679	124,755	590,459	65,282	74,073	24,413	226,728	19,597	410,093	180,366	92	29,638	150,820	†3,564
Yazoo & Mississippi Valley	1,371	853,331	194,863	1,117,396	151,002	128,177	15,735	351,337	28,009	674,260	443,136	2,137	34,590	410,683	161,543

FIVE MONTHS OF FISCAL YEAR.

Atchison, Topeka & Santa Fe	7,459	21,373,875	$7,605,627	$31,376,370	$3,965,370	$5,613,447	$616,360	$8,320,186	$638,635	$19,153,998	$12,222,372	.....	$1,104,737	$11,117,635	$1,203,707
Atlanta, Birmingham & Atlantic	642	560,878	200,675	806,571	95,575	136,132	40,276	285,497	28,931	586,411	220,160	.....	31,500	188,660	40,115
Atlantic Coast Line	4,407	6,834,938	2,154,088	9,690,508	1,461,546	1,473,472	165,438	3,348,181	284,605	6,733,242	2,957,266	.....	450,000	2,507,266	346,058
Bessemer & Lake Erie	201	3,121,139	154,508	3,302,652	286,517	499,946	26,573	796,934	32,966	1,642,936	1,659,716	.....	20,000	1,639,716	†70,931
Buffalo & Susequehanna	373	839,284	94,237	964,454	175,824	207,104	12,795	334,840	32,844	763,407	201,047	$626	20,000	180,421	46,819
Central New England	294	829,208	158,405	1,045,019	194,321	106,418	8,446	339,337	14,000	662,522	382,497	.....	28,000	354,497	196,709
Central of Georgia	1,916	3,240,141	1,249,098	4,899,432	640,111	891,303	132,213	1,515,721	184,947	3,364,295	1,535,137	26,465	186,232	1,375,370	66,759
Chesapeake & Ohio	1,896	8,676,570	2,029,631	11,147,327	1,342,512	2,047,561	181,359	2,933,327	203,575	6,708,334	4,438,993	12,433*	331,900	4,094,660	†249,290
Chicago & Alton	998	3,419,741	1,764,259	5,620,801	523,016	592,456	177,114	1,655,846	139,313	3,087,745	2,533,056	5,643*	150,000	2,377,413	593,603
Chicago & East. Illinois	566	3,376,441	751,287	4,377,128	518,934	811,391	80,443	1,488,893	173,829	3,073,490	1,303,638	7,185*	112,557	1,183,896	†181,193
Chicago & Erie	270	1,308,633	345,081	1,792,627	200,153	422,712	55,609	818,012	37,098	1,533,584	259,043	1,491	56,997	203,537	37,496
Chicago & North Western	7,635	19,833,157	8,029,947	30,098,782	3,781,899	3,170,952	470,603	10,336,258	456,294	18,216,006	11,882,776	23,720	1,150,000	10,756,496	933,252
Chicago, Lake Shore & Eastern	580	1,598,605	.....	1,737,339	146,142	385,329	5,448	529,648	26,726	1,093,293	644,046	.....	15,000	629,046	†172,069
Chicago, Rock Island & Pacific	7,423	15,753,733	7,721,442	24,962,903	3,914,709	3,173,321	548,557	8,874,310	620,622	17,131,519	7,831,384	49,906*	909,446	6,872,032	29,754
Chicago, St. Paul, Minn. & Omaha	1,730	3,730,401	1,867,259	5,987,388	826,048	591,944	107,085	2,037,841	126,657	3,689,575	2,297,813	4,563	264,848	2,037,528	262,088
Delaware, Lackawanna & Western	893	10,515,938	3,046,236	14,442,805	1,659,688	1,803,009	244,609	3,849,035	277,217	7,833,558	6,609,247	111,935	504,000	6,217,182	†99,674
Duluth, Missabe & Northern	273	6,402,128	148,924	6,577,617	428,032	445,060	5,857	744,043	53,117	1,676,109	4,901,508	46,864	265,404	4,682,968	†600,538
Elgin, Joliet & Eastern	239	997,017	254	1,035,326	114,168	169,403	12,154	315,949	31,756	643,430	391,896	.....	47,500	344,396	†92,092
El Paso & Southwestern	867	2,261,737	388,693	2,784,206	340,842	398,769	44,691	742,240	101,341	1,627,883	1,156,323	.....	55,933	1,100,390	†60,409
Erie	1,902	13,888,354	3,745,090	18,887,889	2,120,095	3,873,862	380,787	6,138,617	374,823	12,888,184	5,999,705	238,482	482,616	5,755,571	827,174
Grand Rapids & Indiana	590	1,105,498	792,250	2,048,141	212,031	265,682	52,104	742,037	66,400	1,338,254	709,887	1,281	105,945	605,223	14,856
Great Northern	6,851	20,166,435	5,134,157	26,669,911	4,726,427	2,800,299	291,292	6,389,128	427,878	14,635,024	12,034,887	136,648	1,027,235	11,144,300	†260,262
Gulf, Colorado & Santa Fe	1,518	4,217,787	1,283,220	5,767,847	866,090	942,438	97,386	1,882,644	166,285	3,954,843	1,813,004	.....	145,462	1,667,542	921,083
Illinois Central	4,519	15,120,783	4,803,880	22,660,165	3,013,828	5,359,861	492,675	7,633,398	487,739	16,987,501	5,672,664	14,090*	943,074	4,715,500	†553,841
Kansas City Southern	827	2,804,609	564,449	3,692,806	413,018	432,882	106,976	1,156,089	128,912	2,237,877	1,454,929	.....	141,649	1,313,280	†138,097
Louisville & Nashville	4,365	13,903,564	4,400,873	19,471,616	2,236,517	3,320,804	405,058	6,135,783	384,999	12,483,161	6,988,456	50,484*	561,688	6,376,284	1,287,435
Maine Central	931	2,032,802	1,451,905	3,722,982	647,885	470,679	38,792	1,239,687	104,582	2,501,625	1,221,357	15,474	155,017	1,081,814	†315,249
Mobile, Jackson & Kansas City	402	453,915	127,260	621,852	97,105	74,456	7,891	202,475	42,046	423,973	197,880	.....	14,468	183,412	73,471
New York, New Haven & Hartford	2,004	11,067,416	10,222,776	23,295,704	2,920,414	2,703,903	122,250	9,316,955	450,305	15,513,827	7,781,877	568,734	1,417,000	6,933,612	†445,040
Norfolk & Western	1,921	10,359,607	1,554,647	12,323,596	1,329,037	2,037,273	191,491	3,494,914	260,444	7,313,159	5,010,437	1,021*	432,700	4,576,716	†230,175
Northern Pacific	5,649	22,164,016	8,126,603	32,004,574	3,605,125	3,437,662	353,016	8,443,757	421,203	16,260,763	15,743,811	215,765	1,348,620	14,610,956	154,793
St. Louis & San Francisco	4,727	10,071,368	3,981,249	15,205,771	2,507,776	2,118,437	310,698	5,161,696	473,773	10,572,380	4,633,392	.....	628,378	4,005,014	†387,312
St. Louis, Brownsville & Mexico	456	288,507	134,685	455,920	83,636	60,121	13,607	167,952	24,979	350,295	105,625	72	15,000	90,697	101
Toledo, St. Louis & Western	451	1,186,135	224,420	1,514,807	173,607	206,788	43,816	485,488	45,636	955,335	559,472	.....	57,500	501,972	†117,388
Wisconsin Central	1,023	2,360,128	756,346	3,308,816	383,976	366,247	120,644	1,103,351	101,243	2,075,461	1,233,355	3,606	146,543	1,090,418	†50,001
Yazoo & Mississippi Valley	1,371	2,868,238	878,461	4,001,601	925,761	772,131	81,248	1,585,357	119,329	3,483,826	517,775	16,107	172,950	360,932	†121,481

*Deficit. †Decrease.

Railroad Officers.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

E. T. Kennan has been appointed Auditor of the Indianapolis Union.

H. M. Atkinson, President, and P. S. Arkwright, Vice-President, of the Atlanta, Birmingham & Atlantic, have been appointed receivers.

Mr. W. H. Ardley has been appointed General Auditor of the Grand Trunk Pacific, with headquarters at Montreal, succeeding N. J. Power.

C. H. Booth has been appointed Assistant Treasurer and Cashier of the Delaware & Hudson, with office at New York. This is a new office.

W. C. Brown, Senior Vice-President of the New York Central Lines, has been elected President, effective February 1, succeeding W. H. Newman, resigned.

J. W. Coon, Chief Clerk to the Third Vice-President of the Baltimore & Ohio, has been appointed Assistant to the Third Vice-President, succeeding J. G. Walber.

Paul Shoup, Assistant General Passenger Agent of the Southern Pacific, at San Francisco, Cal., has been appointed Assistant to W. F. Herrin, Chief Counsel.

K. T. Taylor, district claim agent of the Northern Pacific at Fargo, N. Dak., has been appointed Chief Clerk in the Claim Department, succeeding W. F. Ever, promoted.

W. S. Roney, Auditor of the Vandalia, has been appointed Assistant Comptroller. J. E. Merion succeeds Mr. Roney. John Theobald has been appointed General Accountant.

A. E. Sweet, Superintendent of the Southwestern district of the Chicago, Rock Island & Pacific, at Topeka, Kan., has been appointed Assistant to the Second Vice-President, with office at Chicago.

Operating Officers.

A. M. Keppel has been appointed Superintendent of the Washington Terminal Co., succeeding George W. Martin, resigned.

H. Hatcher, Assistant Superintendent of the Southern Railway at Columbus, Miss., has been appointed Superintendent at Columbus.

George E. Cooledge has been appointed Superintendent of Dining Car Service of the Lehigh Valley, with office at Easton, Pa., succeeding J. Howard Seal.

C. E. Meyer has been appointed Trainmaster of the Lake Erie & Western and the Northern Ohio, with office at Sandusky, Ohio, succeeding J. W. O'Brien, promoted.

M. M. Vincent, Assistant General Manager of the National Car Line Co., Chicago, has been appointed General Manager, succeeding Frank A. Spink, resigned to go with another road.

E. I. Ford, Trainmaster of Terminals of the Chesapeake & Ohio at Newport News, Va., has been appointed Superintendent of Terminals, in charge of all operation except that assigned to the General Agent.

E. S. Van Tassel, the announcement of whose resignation as Trainmaster of the Colorado division of the Union Pacific appeared in our issue of October 9, has associated himself with the New York office of Manning, Maxwell & Moore, New York.

John G. Walber, Assistant to the Third Vice-President of the Baltimore & Ohio, has been appointed General Superintendent of Transportation, with office at Baltimore, Md., succeeding Arthur Hale, whose resignation we have previously announced.

Judge T. J. Freeman, Receiver of the International & Great Northern, has assumed the title of General Manager. Horace W. Clarke, General Superintendent, has been appointed Assistant General Manager, and J. C. Dailey, Superintendent, succeeds Mr. Clarke. The office of Superintendent has been abolished.

H. E. Parker, Superintendent of Terminals of the Chesapeake & Ohio at Newport News, Va., has been appointed General Agent at Newport News and will have supervision of the export, import and coastwise merchandise business, and will perform such other duties as may be assigned to him by the General Manager.

J. B. Wallace, recently appointed Superintendent of the Mexican Central at Saltillo, Coah., Mex., was born in 1867 in Ohio. After a common school education he began railway work in 1882 on the New York, Pennsylvania & Ohio, now the Erie, as operator. He later became despatcher. In 1903 he was appointed Chief Despatcher of the Chicago & Alton at Bloomington, Ill., and later became Passenger Trainmaster. In June, 1908, he became Terminal Superintendent of the Mexican Central at El Paso, Tex., which position he held until his recent appointment.

C. W. Jones, Superintendent of the Iowa division of the Chicago, Rock Island & Pacific, at Des Moines, Iowa, has been appointed General Superintendent of the Southwestern district, with office at Topeka, Kan., succeeding A. E. Sweet, promoted. H. P. Greenough, Superintendent of the El Paso division, at Dalhart, Tex., succeeds Mr. Jones. H. L. Reed, Superintendent of the St. Louis division, at Eldon, Mo., succeeds Mr. Greenough. A. W. Kelso, Superintendent of the Chicago Terminal division, at Chicago, succeeds Mr. Reed, and F. M. Patt, Trainmaster of the Illinois division, succeeds Mr. Kelso as Acting Superintendent of the Chicago Terminal division.

The headquarters of J. P. Folger, Trainmaster of the Idaho division of the Oregon Short Line, has been changed from Pocatello, Idaho, to Kemmerer, Wyo., and the North Kemmerer branch has been put under his jurisdiction. The headquarters of C. L. Eldred, Trainmaster of the Idaho division, has been changed from Pocatello, Idaho, to Nampa, with jurisdiction over the Fourth district of the Malheur Valley, Boise district and Glenns Ferry yard. George J. Cunningham, depot master of the Ogden (Utah) Union Depot, has been appointed Trainmaster of the Idaho division, with headquarters at Pocatello, Idaho, with jurisdiction over the Third and Fifth districts of the Minidoka & Southwestern and Pocatello yard.

The terminals and floating equipment of the Pennsylvania in and around New York have been placed in a newly created division to be known as the Hudson division. It includes the New York Bay Railroad, east of Newark Bay, and branches, including Greenville yard and piers; the line from Harsimus Junction to Harsimus Cove, including the freight yard, elevators and piers at Harsimus Cove; the ferry stations in New York and Brooklyn; the freight stations in New York, including One Hundred and Twenty-fifth street station, East river station and stations in Brooklyn; the Hoboken shops, and ferries between Jersey City, New York and Brooklyn. A. M. Parker, Principal Assistant Engineer of the New Jersey division, has been appointed Superintendent of the Hudson division. George P. Miller, Assistant Engineer of the New York division, succeeds Mr. Parker. R. V. Massey, Assistant Engineer of the Schuylkill division, succeeds Mr. Miller, with office at Jersey City. J. P. Charlton, Supervisor of the Schuylkill division at Norristown, Pa., succeeds Mr. Massey, with office at Reading, Pa.

John G. Walber, Assistant to the Third Vice-President of the Baltimore & Ohio, has been appointed General Superintendent of Transportation of the Baltimore & Ohio, succeeding Arthur Hale, resigned. Mr. Walber was born in 1871 at Cincinnati, Ohio. After a public school education he began railway work in February, 1885, in the President's office of the Ohio & Mississippi, now part of the Baltimore & Ohio Southwestern. He was later made Secretary to the President. In 1893 he was appointed Secretary to the Second Vice-President and Traffic Manager of the Baltimore & Ohio Southwestern, and in 1896 was made Secretary to the Vice-President and General Manager, with office at Cincinnati, Ohio. In 1898 he became Chief Clerk to the Vice-President and General Manager. Four years later he was made also Assistant Secretary and put in direct charge of the Taxes and Insur-

ance departments. In 1904 he was made Assistant to the General Manager, and in 1906, Assistant General Manager. In January, 1908, he was appointed Assistant to the Third Vice-President of the Baltimore & Ohio, and he was appointed to his present position on January 1 of the current year.

Hiram W. Sheridan, whose appointment as Superintendent of the Southern Pacific, at Sacramento, Cal., has been announced in these columns, was born February 9, 1864, near La Crosse, Wis. He was educated at the La Crosse schools and business college. He began railway work April 15, 1880, as freight clerk on the Chicago & North Western, remaining in the services of this road until 1884 as operator, agent, brakeman and conductor. From 1884 to 1886 he was in the service of the Union Pacific as operator, brakeman, switchman and conductor. From 1886 to 1890 he was with the Boston & Maine as operator, conductor and yardmaster. From 1890 to 1898 he was with the Kansas City, Wyandotte & Northwestern, now a part of the Missouri Pacific, as conductor, yardmaster, Despatcher, Roadmaster, Trainmaster and Superintendent. He re-entered the service of the Union Pacific in 1898, serving until 1902, as yardmaster, traveling conductor, Trainmaster and Assistant Superintendent. In 1902 he was made yardmaster of the Atchison, Topeka & Santa Fe, at Kansas City, Mo., and in 1903 he served as yardmaster of the Chicago, Rock Island & Pacific at Kansas City, Mo. In 1904 he was appointed yardmaster of the St. Louis, Iron Mountain & Southern, at Texarkana, Ark., and later Trainmaster at McGehee, Ark. In November, 1906, he returned to the Union Pacific as yardmaster, at Cheyenne, Wyo., and in February of the following year he was promoted to the position of Trainmaster at Green River, Wyo. In January, 1908, he was appointed Assistant Superintendent of the Sacramento division of the Southern Pacific, which position he held until his appointment as Superintendent.

Traffic Officers.

J. T. Redmon has been appointed Commercial Agent of the Iowa Central at Peoria, Ill.

J. W. Brooks has been appointed Traveling Freight Agent of the Chicago, Cincinnati & Louisville, with office at Muncie, Ind.

C. I. Fuchs has been appointed to the new office of Traveling Freight Agent of the Missouri Pacific, at Chattanooga, Tenn.

J. G. North has been appointed Commercial Agent of the Macon & Birmingham, with office at Macon, Ga., succeeding W. E. Streyer.

I. G. Hipsley has been appointed City Freight and Passenger Agent of the Wabash at Council Bluffs, Iowa, succeeding C. J. Sayles, promoted.

S. E. Nirdlinger has been appointed General Agent, Freight and Passenger departments, of the Chicago, Burlington & Quincy at Leavenworth, Kan.

D. P. Drewery, Chief Clerk in the Passenger department of the Grand Trunk at Buffalo, has been appointed Traveling Passenger Agent at Cortland, N. Y.

The office of the Traffic Manager of the Missouri & North Arkansas has been changed from Eureka Springs, Ark., to the Security building, St. Louis, Mo.

J. J. Seay, Traveling Freight Agent of the Southern, at Rome, Ga., has been appointed Commercial Agent, with office at Rome. C. T. Cope succeeds Mr. Seay.

R. M. Locke has been appointed General Freight and Passenger Agent of the Charlotte Harbor & Northern, with office at Arcadia, Fla., succeeding J. L. de Treville, resigned.

Frank A. Spink, General Manager of the National Car Line Co., Chicago, has been appointed Traffic Manager of the Chicago & Western Indiana and the Belt Railway of Chicago, with office at Chicago.

H. J. Neff, Traveling Freight Agent of the Trinity & Brazos Valley, at Houston, Tex., has been appointed Chief Rate Clerk in the general freight offices. J. N. Steele, Traveling Freight and Passenger Agent of the Texas Midland, at Houston, succeeds Mr. Neff.

J. B. Hayes, Agent of the Wabash at Pontiac, Ill., has been appointed Commercial Agent of that road at Alton, Ill., in charge of the freight and passenger business, reporting to the General Freight Agent.

Herbert D. Howe has been appointed General Land and Tax Agent of the New York Central Lines, with office in Chicago. Mr. Howe is of the firm of Glennon, Cary, Walker & Howe, Attorneys for the New York Central.

C. B. Condon, Commercial Agent of the Minneapolis & St. Louis and the Iowa Central, at Kansas City, Mo., has been appointed Assistant General Freight Agent, with office at Minneapolis, Minn. W. M. Hardin succeeds Mr. Condon.

J. A. Russell has been appointed Traveling Passenger Agent of the Missouri Pacific, the St. Louis, Iron Mountain & Southern, and leased, operated and independent lines, at Chicago, succeeding H. D. Armstrong, resigned to engage in other business.

O. G. Burrows, Commercial Agent of the Kansas City, Mexico & Orient, at Wichita, Kan., has been appointed General Traffic Manager of the Kansas City, Mexico & Orient of Texas, with office at Sweetwater, Tex. J. R. Holcomb, Commercial Agent of the Quincy, Omaha & Kansas City, at Quincy, Ill., succeeds Mr. Burrows.

Vernon V. Beard, for several years Assistant General Eastern Passenger Agent of the New York Central & Hudson River, and for the last year or two in charge of the Excursion department of that road, has resigned, and has taken a position with the Gillespie Kinports Company, excursion managers, New York and Philadelphia.

The office of General Agent of the Pennsylvania at New York has been abolished, and the traffic duties heretofore performed by the General Agent have been assigned to the new office of Division Freight Agent. Gilbert H. Cobb, Division Freight Agent at Baltimore, has been appointed Division Freight Agent at New York, with office at 2 Beaver street.

James Nelson Tittemore, whose appointment as General Traffic Manager of the Pere Marquette has been announced in these columns, was born March 2, 1864, in Waushara county, Wisconsin. He was educated in the common schools at Eureka and Poy Sippi, Wis. He began railway work in 1880 as station agent of the Milwaukee, Lake Shore & Western, now a part of the Chicago & North Western, at Kempster, Wis. Later he served in the same capacity at Summit Lake, Eagle River and Prentice, Wis. He then became operator for the same road at Sheboygan, Wis., after which he was appointed traveling auditor of the Chicago & North Western, returning later to the Milwaukee, Lake Shore & Western as Traveling Passenger Agent. He again left this road to become Traveling Freight Agent of the Minneapolis, St. Paul & Sault Ste. Marie, later becoming Chief Clerk in the Traffic Department of that road. He then went to the Great Northern as Traveling Freight Agent, later being appointed General Freight Agent of the Sioux City & Northern and the Pacific Short Line, a part of the Great Northern, finally becoming Assistant to the President of these roads. In May, 1894, he was appointed General Freight and Passenger Agent of the Des Moines, Northern & Western, now a part of the Chicago, Milwaukee & St. Paul. In March, 1898, he was appointed General Freight Agent of the Iowa Central, and in September, 1899, he was appointed Acting General Manager. In January,

James N. Tittemore.

1905, he was made Traffic Manager of the Iowa Central and the Minneapolis & St. Louis, which position he held until his recent appointment.

James H. R. Parsons, who has for a number of years been in the office of J. C. Stubbs, Vice-President and Traffic Director of the Harriman Lines at Chicago, has been appointed General Passenger Agent of the Morgan's Louisiana & Texas Railroad & Steamship Co., and the Louisiana Western, succeeding Frank E. Batturs, whose appointment as Assistant General Passenger Agent of the Southern Pacific, at San Francisco, Cal., has been announced in these columns.

R. J. Menzies, Commercial Agent of the New York Central & Hudson River and the West Shore, and New York District Agent of the New York Central fast freight lines, has been appointed General Eastern Freight Agent of the territory of Greater New York, Jersey City, Bayonne, Hoboken, Weehawken, Long Island and all stations south of Hudson, Catskill and Boston Corners. He is to have charge of the solicitation of both east and westbound freight traffic, as well as traffic of all the fast freight lines operating over the New York Central & Hudson River and the West Shore.

Engineering and Rolling Stock Officers.

Frank Rusch has been appointed Master Mechanic of the Chicago, Milwaukee & St. Paul lines west of Butte at Seattle, Wash.

R. D. Parker, Resident Engineer of the Houston & Texas Central, has been appointed Chief Engineer of the Texas Railroad Commission, succeeding R. A. Thompson, resigned.

George P. Smith, Chief Engineer of the Lake Erie & Western, has been appointed Chief Engineer of the Cleveland, Cincinnati, Chicago & St. Louis, succeeding William M. Duane, who resigned some months ago.

B. P. Flory, Mechanical Engineer of the Central of New Jersey, has been appointed Superintendent of Motive Power of the New York, Ontario & Western, succeeding G. W. West, deceased. G. W. Rink, chief draftsman of the Central of New Jersey, succeeds Mr. Flory.

OBITUARY.

C. H. Yoakum, General Attorney for the St. Louis & San Francisco, and brother of B. F. Yoakum, died at Ft. Worth, Tex., on January 1.

Major Isaac W. Maclay, at one time Chief Engineer of the Long Island Railroad and a civil engineer, died December 29 at his home in Yonkers, N. Y.

D. D. Carothers, Chief Engineer of the Baltimore & Ohio, died January 2 at his home in Baltimore, Md. He was born in 1860 in Washington county, Ohio, and began railway work in 1882 as rodman and assistant engineer on the Northern division of the Wheeling & Lake Erie. A year later he was made assistant engineer, and in 1885 he became Chief Engineer of the Columbus & Cincinnati Midland, now part of the Baltimore & Ohio. In 1889 he was Trainmaster and Chief Engineer, and in 1890 was appointed Engineer, Maintenance of Way, of the Baltimore & Ohio Southwestern. In December, 1901, he was appointed Superintendent of the Chicago division of the Baltimore & Ohio, and a year later was made General Superintendent of the Baltimore & Ohio Southwestern. On February 1, 1904, he was appointed Chief Engineer of the Baltimore & Ohio. F. L. Stuart, Chief Engineer of the Erie, and a close personal friend of Mr. Carothers, adds: "Mr. Carothers typified not only a successful engineer but a success as a man. As an engineer and railway official he had initiative power, and his education and long experience, backed up by one of his most dominant characteristics which was common sense, gave great strength to his views among other men of his profession. As a man his sterling qualities and manliness drew everyone that came in contact with him to him. The men that worked in close touch with him were the men that appreciated and respected his opinions most. Notwithstanding the position in the railway world that he had made for himself, those who knew him felt that this was but the beginning of his true usefulness; and they all feel a deep sense of personal loss at his death."

Railroad Construction.

New Incorporations, Surveys, Etc.

Algoma Central & Hudson Bay.—Application will be made at the next session of the Canadian Parliament for an act extending the time for building this line from the Canadian Pacific main line north to a point on James Bay.

Alsek & Yukon.—The company is applying for an act to extend the time within which the proposed railway may be built and also for other purposes. The company was incorporated in 1907 with power to build a railway from Pleasant Camp, on the Klihini river, at the international boundary of British Columbia, in a northwesterly direction along valleys of the Klihini, Tatsenshini, Shakwak and Alsek rivers, and Kluane lake, Donjek and White Riversby, the most feasible route to the international boundary between Yukon and Alaska. Lewis and Smellie are the solicitors for the applicants.

Athabasca Railway.—Application will be made at the next session of the Canadian Parliament for an act extending the time for building this projected line from Edmonton, Alb., northeast, following the north bank of the North Saskatchewan river to township 59, range 19, west of the fourth principal meridian, thence northeast past Smoky Lake to the western end of Lac Labiche, thence in a northerly direction to the junction of the Athabasca and Clearwater rivers.

Beaumont & Great Northern.—Press reports from Beaumont, Tex., indicate that the property of this company, along with 150,000 acres of timberland in Polk county, Tex., has been bought by a syndicate of which B. F. Yoakum is the head, and also that this syndicate proposes to build a cut-off between Beaumont, Tex., and Dallas or Fort Worth and will utilize the Beaumont & Great Northern and several other railway properties in the vicinity of Beaumont.

Big Bend Transit Co.—See Spokane & Inland Empire.

Bluffton, Berne & Celina Traction.—Incorporated in Indiana, with $50,000 capital, to build an interurban line from Bluffton, Ind., southeast to Celina, Ohio, 47 miles. The company's headquarters will be in Bluffton. R. Sourer, B. Bates and R. Schug are directors.

Chicago, Kenosha & Milwaukee (Electric).—Application has been made by this company to the Wisconsin State Railroad Commission for a certificate of necessity and convenience to build a line from Kenosha, Wis., south to the Wisconsin-Illinois state line. The line is to be extended south through Waukegan, Ill., to Chicago. George G. Wilcox is President; Volney Foster, Vice-President; F. R. Grover, Secretary and Treasurer.

Chicago, Milwaukee & St. Paul.—Reports from Milwaukee indicate that this company has notified the common council that it has under consideration a plan for depression and elevation of its tracks in the northwestern part of the state, and that resolution has been introduced in the common council asking for the appointment of the commission of experts to decide upon the plan for abolishing all grade crossings in that section.

Clinton, Danville & Peoria.—Incorporated in Illinois, to build a line from Chicago south to coal fields in the east central part of Illinois. W. S. Bogle, R. K. Hammond, H. Hafer, J. E. Hitt, J. K. Deing, G. W. Traer and J. E. Ford, all of Chicago, are incorporators.

Colorado & Mexico.—Incorporated in Arizona, by men of Bisbee, Ariz., to build a railway from Douglas, Ariz., to Cortland.

Denver, Kingfisher & Gulf.—The rights, franchises and property of this company have been bought, it is said, by a new company headed by W. M. Bonson, of Dubuque, Iowa, and C. G. Jones, of Oklahoma City, Okla. The D., K. & G., which was financed by D. K. Cunningham and other residents of Kingfisher, made a permanent survey some years ago from Oklahoma City northwest through Kingfisher, Kiel and Okeene, and had finished about two-thirds of the grading between Okeene and Kingfisher. The new company owns

about 8,000 acres of coal lands in northwestern New Mexico, to which point the line is ultimately to be extended.

ESTACADO & GULF.—Press reports say that this company is buying material for building this line from McCauley, Tex., northeast to Stamford and Abilene. Work is now under way from McCauley southwest to Roby. It is expected to have trains in operation on some of the line by April. (Sept. 11, p. 932.)

FAIRBURN & ATLANTA RAILWAY & ELECTRIC CO.—Incorporated in Georgia, with $75,000 capital, to build an electric line from Fairburn, Ga., north to College Park, six miles. The incorporators include J. F. Golightly, of Atlanta; W. T. Roberts, J. H. Harris and J. F. Logino, all of Fairburn.

GLENRAY & RICHWOOD.—Incorporated in West Virginia to build a line from Alderson, in Monroe county, W. Va., north to Richwood, 40 miles, where connection is to be made with the Baltimore & Ohio. Surveys made and part of the rights of way secured. It is expected that work will be started early this spring. The incorporators include F. M. Arnold, A. G. Corbett, H. E. Rugh, A. J. Davis and H. F. Stratton.

GULF, TEXAS & WESTERN.—D. B. Cane, of Tyler, Tex., is quoted as saying that a line from Fort Worth, Tex., northwest to the coal fields of Young and Jack counties, will soon be built. Work has already been started at Jacksboro, and as soon as terminal facilities can be arranged for construction is to be started from Fort Worth. The line is eventually to be extended to either Roswell, N. Mex., or Texico. The charter already granted only provides for a line from Burrs Ferry, Tex., in Newton county, on the Sabine river, west through Dallas, Fort Worth and Jacksboro, to Benjamin, in Knox county. (Nov. 13, p. 1375.)

IDAHO & WASHINGTON NORTHERN.—The newspapers report that work on the extension of this road from Newport, Wash., north to Cement, 52 miles, is to be rushed. Grant, Smith & Co., of Spokane, who have the grading contract, have sublet, it is said, all the work with the exception of the tunnel, to be 1,100 ft. long, at Blueside, about 40 miles south of Newport. Piling for a large trestle across Ashenfeiter Bay is being driven. About 500 are now at work, and more men will be put to work as soon as the weather permits. (Dec. 11, p. 1560.)

LARAMIE, HAHNS PEAK & PACIFIC.—Orders are said to have been given recently by this company for material to build 70 miles of line. The road is being extended south to a point in Colorado. It is expected that trains will be in operation soon from Laramie, Wyo., into Routt county, Colorado. (Dec. 11, p. 1560.)

MEXICAN CENTRAL.—Surveys are said to have been made by this company for reconstructing the division between Irapuato, Guanajuato and Guadalajara, 161 miles. The estimated cost of the work is $2,000,000.

MOUNTAIN VALLEY & PLAIN.—The newspapers report that this company has made financial arrangements and that construction work will be pushed forward rapidly on this proposed line from Cimarron, N. Mex., east through the Panhandle of Texas, to Oklahoma City, 400 miles, of which 150 miles will be in Texas. The headquarters of the company are at Dalhart, Tex. D. W. Herrington, of Dalhart, is interested. (Sept. 4, p. 889.)

NORTH MISSOURI CENTRAL.—Incorporated in Missouri, with a capital stock of $6,000,000, to build a railway from Mexico, Mo., through Columbia and Cedar City to Jefferson City, about 60 miles. The directors include T. F. Whiteside, T. S. Gordon and A. J. Estee, of Columbia, and W. C. Carroll, of New York.

OHIO & MICHIGAN SOUTHERN (ELECTRIC).—Incorporated in Michigan, with $17,000,000 capital, to take over the Toledo, Ann Arbor & Detroit, a partially completed electric line between Toledo, Ohio, and Ann Arbor, Mich. Former Governor Andrew E. Lee will be President of the new company, with headquarters in Toledo. In addition to Mr. Lee, whose present address is at Vermillion, S. Dak., the directors include W. E. Niles and S. D. Williams, of Sioux Falls; O. Zazel, of Atlanta, Minn.; D. C. F. Niles, of Duluth, and H. A. Reese, of Chicago.

PENNSYLVANIA ROADS (ELECTRIC).—Surveys are said to be under way for a line from Slippery Rock, Pa., north to Grove City, 10 miles, also beyond that place north to Meadville, 35 miles. The first section is projected by H. H. Long, of Slippery Rock, Pa.; J. A. Jolliffe, of Wheeling, W. Va., and S. L. McClure, of Washington, Pa., while the section north from Grove City is projected by Cleveland, Ohio, capitalists. H. C. Graves is in charge of the work between Slippery Rock and Grove City.

Surveys are said to have been started for an electric line to be built from Mars, near the southern boundary of Butler county, Pa., west to Rochester, in Beaver county, 14 miles. The project is said to be backed by Pittsburgh capitalists. The route partly follows an old survey that was never developed.

RIMOUSKI INTERNATIONAL.—The Canadian Parliament will be asked at its next session to pass an act incorporating this company with power to build a railway from a point between the city of Rimouski, Que., and the wharf at Father Point, to Edmundston, N. B., through the townships of Duquesne, Chenier, Biencourt, Robitaille and Rouillard. It is also the intention of this company to operate vessels on the navigable waters with which the proposed railway will connect, also to build telegraph and telephone lines, hotels, parks, pleasure resorts, etc. L. M. Asselin, Rimouski, Que., is solicitor for the applicants.

SALT LAKE & OGDEN.—An officer is quoted as saying that this road will be electrified. Simon Bamberger, President and General Manager, is now making arangements to finance the change. The road is 50 miles long and parallels the Oregon Short Line between the cities named. (Oct. 23, p. 1227.)

SAN LUIS VALLEY (ELECTRIC).—Incorporated in Colorado with $500.000 capital to build a line through Saguache, Rio Grande and Conejos counties in San Luis valley, Colo. J. M. Moses is said to be interested.

SOUTHERN PACIFIC.—Newspaper reports say that a cut-off is to be built by this company from Beaverton, Ore., east to Willsburg (Portland), 10.17 miles, and will cost about $1,000,000. Of this amount, $214,894 is for the right of way, material for bridges, and for the grading.

SPOKANE & INLAND EMPIRE (ELECTRIC).—This company and the Big Bend Transit Co. have both filed in the land office claims for the same ground in the Spokane-Indian reservation, as site for terminals, in the Big Bend country. The land is at the mouth of the Spokane river, where it joins the Columbia river. Terminal rights were granted the Transit company by the Department of the Interior some time ago, but upon the rights lapsing, the Spokane & Inland filed an application for the same site. The Transit company has applied for a renewal of the old lease. It is understood that the decision of the Department of the Interior in granting the site for terminals, will decide which road will build into the Big Bend country.

STAMFORD & NORTHWESTERN.—Contract is said to have been let by this company for building the first section of its proposed line from Stamford, Tex., northwest. Additional contracts are to be let at once and the work pushed to completion. The plans call for a line from Stamford northwest to a point in Dickens county, about 65 miles. P. G. Burns, Chief Engineer, Stamford. (Nov. 20, p. 1419.)

WEST VIRGINIAN ROADS.—A franchise has been granted to Dr. Geo. Keener, of Weston, W. Va., by officials of that place, to build an electric line from Weston south to Bendale, three miles. The terms provide that work must be started within six months and the line finished within one year.

YELLOWHEAD PASS COAL & RAILWAY COMPANY.—Application is to be made by this company to the Canadian Parliament for incorporation. The company plans to build a line from the Grand Trunk Pacific main line, west of Pembina Crossing, Alb., southwesterly to the Embarras river, thence southerly to the headwaters of the Little Pembina river, about 100 miles, and from the Grand Trunk Pacific main line along the Embarras river, southwesterly to the McLeod river, about 25 miles. J. A. Ritchie, of Ottawa, is the solicitor.

YOUNGSTOWN & OHIO.—Press reports say that this company will put in operation this month the extension from Lisbon, Ohio, southeast to East Liverpool. (R. R. G., May 8, p. 656.)

Railroad Financial News.

ATLANTA, BIRMINGHAM & ATLANTIC.—H. M. Atkinson, President, and P. S. Arkwright, Vice-President, have been appointed receivers, the interest on $8,173,000 outstanding bonds having been defaulted. The Atlanta, Birmingham & Atlantic bought the Atlanta & Birmingham in 1906 and the two roads were consolidated, making a total of 498 miles of line owned.

BEAUMONT & GREAT NORTHERN.—R. C. Duff, representing, it is said, B. F. Yoakum, chairman of the executive committee of the Chicago, Rock Island & Pacific, has bought a controlling interest in the Beaumont & Great Northern, which operates 34 miles of line from Trinity, Tex., to Livingston. (See this company under Railroad Construction.)

BOSTON & LOWELL.—The company is to sell at auction on January 13, in Boston, Mass., $250,000 of its stock. There is now outstanding $6,599,400 stock.

CENTRAL PACIFIC.—The Guaranty Trust Co., New York, is offering at 97¾, $3,000,000 first refunding mortgage 4 per cent. guaranteed bonds of 1899-1949. Of the authorized issue of $100,000,000 bonds there is outstanding $99,801,000. The bonds are guaranteed principal and interest by the Southern Pacific, and are a first mortgage on about 1,347 miles of road. At the offering price they yield about 4.10 per cent.

CHICAGO & WESTERN INDIANA.—William Salomon & Co. and Moffat & White, both of New York, have bought the consolidated mortgage 4 per cent. bonds of 1882-1952, deposited as collateral for $8,000,000 collateral trust 5 per cent. notes, dated December 22, 1908, and called for payment February 1, 1909, and are offering to exchange the mortgage bonds for the notes, giving a $25 cash bonus for each $1,000 note exchanged for a $1,000 bond.

CHICAGO, CINCINNATI & LOUISVILLE.—George A. Fernald & Co., New York, are offering $250,000 6 per cent. prior lien receiver's certificates of 1908-1911 at 100¼. This is part of $1,000,000 receiver's certificates authorized in May, 1908.

CHICAGO, MILWAUKEE & PUGET SOUND.—See Chicago, Milwaukee & St. Paul of Washington.

CHICAGO, MILWAUKEE & ST. PAUL.—See Chicago, Milwaukee & St. Paul of Washington.

CHICAGO, MILWAUKEE & ST. PAUL OF WASHINGTON.—Stockholders have voted to increase the capital stock from $3,000,000 to $100,000,000, and to change the name to the Chicago, Milwaukee & Puget Sound. The entire capital stock of the Chicago, Milwaukee & Puget Sound is to be held in the treasury of the Chicago, Milwaukee & St. Paul.

CHICAGO, ROCK ISLAND & PACIFIC.—Press despatches from St. Joseph, Mo., say that the Chicago, Rock Island & Pacific has bought an interest in the Union Terminal Railway. The Rock Island has been entering the stock yards in South St. Joseph over the tracks of the Union Traction and paying rental.

CLEVELAND & MARIETTA.—A dividend of 5 per cent. on the $2,000,000 stock has been declared. In 1907, 4 per cent. was paid, and in 1906, 3 per cent. The Pennsylvania Company owns $1,788,500 of the stock.

DENVER & RIO GRANDE.—Blair & Co., William Salomon & Co. and Wm. A. Read & Co., all of New York, are offering the unsold portion of $17,500,000 first and refunding mortgage 5 per cent. bonds of 1908-1955 at 92½. Bonds are secured by a mortgage upon over 2,500 miles of line of the Denver & Rio Grande and the old Rio Grande Western, which is now consolidated with the Denver & Rio Grande, and is also secured by the deposit of the outstanding issue of second mortgage bonds and two-thirds ($50,000,000) of the stock of the Western Pacific.

INTERBOROUGH METROPOLITAN.—It is said that the company has sold the $6,000,000 stock of the Third Avenue which it held in its treasury. It is thought that the stock was sold to the general public, no one interest having acquired any very large part of it.

INTERBOROUGH RAPID TRANSIT.—Theodore P. Shonts, chairman of the executive committee, has been elected president, succeeding E. P. Bryan, resigned.

LAKE SUPERIOR CORPORATION.—Robert Fleming and associates, of London, have bought a large part of the securities of the Lake Superior Corporation. The Lake Superior Corporation was incorporated in May, 1904, as successor to the Consolidated Lake Superior Co. Directly or through control of the Ontario Lake Superior Co., the company owns all the capital stock of the following corporations centered around Sault Ste. Marie: Algoma Central & Hudson Bay Railway, Algoma Commercial Co., Algoma Iron Works, Algoma Steel Co., British-American Express Co., International Transit Co., Lake Superior Iron & Steel Co., Lake Superior Power Co., Manitoulin & North Shore Railway, Sault Ste. Marie Pulp & Paper Co., Tagana Water & Light Co., Trans St. Mary's Traction.

NEW ENGLAND INVESTMENT & SECURITY CO.—A. Willard Damon and Henry L. Higginson have been elected trustees, succeeding Nathaniel Thayer and William Skinner. The two trustees who retire are both directors of the New York, New Haven & Hartford, and the change is explained as due to the decree of the Supreme Court of Massachusetts directing the New Haven company to relinquish its interest in 16 trolley lines in Massachusetts. The control of these trolley lines is vested in the New England Investment & Security Co.

NEW YORK CENTRAL & HUDSON RIVER.—See New York State Railways.

NEW YORK, NEW HAVEN & HARTFORD.—See New England Investment & Security Co.

NEW YORK STATE RAILWAYS.—This is the name of a new company which is being organized with the approval of the New York Public Service Commission, Second district, to consolidate the Rochester Railway, the Rochester & Sodus Bay and the Rochester & Eastern Rapid Railway. The new company is to issue $23,140,200 stock, of which $3,862,500 is first 5 per cent. cumulative preferred, $4,500,000 second preferred and $14,777,700 common stock. The Rochester & Eastern Rapid Railway lately increased its capital stock from $1,500,000 to $15,290,200, and bought from the New York Central & Hudson River and the Central (Andrews) Railway Syndicate at par, 50 per cent. of the stock of the Schenectady Railway, all of the stocks of the Utica & Mohawk Valley Railway, and a controlling interest in the stock of the Oneida Railway and the Syracuse Rapid Transit. Horace E. Andrews, President of the Rochester Railway, says in regard to the control of the company:

"The New York Central & Hudson River and the Central Railway Syndicate, as the owners of all of the common stock, namely, $1,100,000, of the Rochester & Sodus Bay Railway, and all the stock, namely, $15,290,200, of the Rochester & Eastern Rapid Railway, will, under the terms of the consolidation agreement, take the common stock of the new corporation in exchange therefor, so that the first preferred stock of the new corporation will have back of it the entire investment of the New York Central & Hudson River and the Central Railway Syndicate, not only in the consolidating companies, but also in the Schenectady, Utica, Oneida and Syracuse properties."

OLD COLONY RAILROAD.—The Massachusetts Railroad Commission has been asked to authorize the issue of $500,000 additional stock to provide for improvements and for floating debt. There is now outstanding $18,871,400 stock.

PENNSYLVANIA.—The directors at the annual meeting in March are to ask the authority of the stockholders to issue $80,000,000 new securities for the purpose of refunding short term notes and bonds falling due in the next two years. There are $60,000,000 three-year collateral trust 5 per cent. notes falling due March 15, 1910, and also $19,997,820 general mortgage 6 per cent. bonds due in July, 1910.

PENNSYLVANIA COMPANY.—See Cleveland & Marietta.

PUBLIC SERVICE RAILWAY (NEW JERSEY).—An initial dividend of two-thirds of 1 per cent. was paid on December 31 on the $37,114,800 stock outstanding. The company is controlled through stock ownership by the Public Service Corporation of New Jersey and operates 657 miles of street railways in New Jersey.

ST. LOUIS & SAN FRANCISCO.—Speyer & Co., New York, are offering at 89½ the unsold portion of $30,000,000 general lien 5 per cent. bonds of 1907-1927. The mortgage securing the bonds will, after June 1, 1909, become a first mortgage on 665 miles of line, subject only to $489,125 existing bonds, for the redemption of which general lien bonds are reserved.

SEABOARD AIR LINE.—Sutro Brothers & Co., New York, are offering a block (about $500,000) of 5 per cent. receivers' certificates series C, of 1909-1912, at 99, yielding about 5⅜ per cent. This is the remainder of a total authorized issue of $4,250,000. The certificates rank equally in every respect with the series A, amounting to $3,000,000, and series B, amounting to $260,000.

THIRD AVENUE.—See Interborough Metropolitan.

UNION TERMINAL RAILWAY.—See Chicago, Rock Island & Pacific.

WABASH.—The directors have declared a semi-annual dividend of 3 per cent. on the debenture A bonds and a dividend of 1 per cent. on the debenture B bonds. Six months ago no payment was made on either issue. In January, 1908, 3 per cent. was paid on the A bonds and 1 per cent. on the B bonds. In 1907, 6 per cent. was paid on the A bonds and 1 per cent. on the B bonds.

Equipment and Supplies.

LOCOMOTIVE BUILDING.

The Maine Central has ordered three Pacific and two eight-wheel passenger locomotives from the American Locomotive Co.

The Saxman Coal & Coke Co. has ordered from A. B. Kaiser & Co., Philadelphia, Pa., one second-hand consolidation locomotive, with cylinders 20 in. x 24 in.

The Paulista Railway (Cia Paulista de Vios Ferreas e Fluviaes), F. de Monlevade, Insp. Gen. and Loco. Supt., Sao Paulo, Brazil, is aking prices on six locomotives.

The Chicago, Cincinnati & Louisville, as reported in the *Railroad Age Gazette* of December 25, has ordered five simple consolidation locomotives from the Baldwin Locomotive Works for delivery February 1.

General Dimensions.

Weight on drivers	156,000 lbs.
Total weight, engine	195,000 lbs.
Cylinders	22 in. x 28 in.
Diameter of drivers	56 in.
Boiler, type	Straight top
" working steam pressure	200 lbs.
" diameter	72 in.
Heating surface, tubes	2,453.7 sq. ft.
" " firebox	169.0 "
" " total	2,622.7 "
Tubes, number	309
" diameter	2 in.
" length	14 ft. 6 in.
Firebox, length	101⅞ "
Firebox, width	65⅞ "
Grate area	46.5 sq. ft.
Tender, style	U-shaped
Tender, water capacity	7,000 gals.
Tender, coal capacity	14 tons

Special Equipment.

Boiler steel	Worth
Firebox steel	Otis
Tires	Standard
Boiler covering	Johns' asbestos
Valves	American balance
Injectors	Friedmann
Couplers	Tower
Headlights	Dressel
Brakes	Westinghouse
Safety valves	Crosby
Lubricators	Chicago
Metallic packing	United States
Steam gages	Crosby
Whistles	Crosby
Sanding device	Leach

The Cincinnati, Hamilton & Dayton, as reported in the *Railroad Age Gazette* of November 27, has ordered ten simple six-wheel switching locomotives from the American Locomotive Co. for delivery in January.

General Dimensions.

Weight on drivers	134,000 lbs.
Total weight, engine	134,000 "
Cylinders	19 in. x 26 in.
Diameter of drivers	51 in.
Boiler, type	Straight top
" working steam pressure	180 lbs.
" diameter	66¼ in.
Heating surface, tubes	1,600 sq. ft.
" " firebox	160 "
" " total	1,760 "
Tubes, number	280
" diameter	2 in.
" length	11 ft.
Firebox, length	108 in.
" width	42 in.
Grate area	31.5 sq. ft.
Tender, style	Sloping
Water capacity	5,000 gals.
Coal capacity	8 tons

Special Equipment.

Boiler steel	Worth
Firebox steel	Otis
Tires	Latrobe
Springs	Railway Steel-Spring
Valves	Allen-Richardson
Injectors	Ohio
Couplers	Simplex
Journal bearings	Bronze, Am. Loco. Co.
Headlights	Adams-Westlake
Brakes	Westinghouse
Tender brake-beams	Sterlingworth
Safety valves	Consolidated
Lubricators	Chicago
Metallic packing	Jerome
Steam gages	Ashton
Whistles	Am. Loco. Co.
Bell ringers	Cook & Strong
Sanding device	Leach
Blow-off valves	Am. Loco. Co.
Driving wheel centers	Steeled cast iron

CAR BUILDING.

The Western Maryland, B. F. Bush, Receiver, has been authorized by the United States Circuit Court to purchase two mail and express cars and two baggage cars.

The British Columbia Electric Co., it is reported, will build twenty-four 42-ft., semi-convertible cars, two observation cars, 13 box and two flat cars. This item is not confirmed.

The Milwaukee Northern Railway, reported in the *Railroad Age Gazette* of December 4 as having ordered 10 trucks from the Baldwin Locomotive Works, is reported to be in the market for additional passenger equipment and complete freight equipment. This item is not confirmed.

The Pittsburgh & Lake Erie has ordered 500 fifty-ton steel hopper cars from the Standard Steel Car Co. These are in addition to the 500 similar cars ordered from this company, as reported in the *Railroad Age Gazette* of December 25. These, with the 1,000 ordered from the American Car & Foundry Co., make a total of 2,000 recently ordered by this road.

IRON AND STEEL.

The International & Great Northern will be in the market early this year for 85-lb. rails to equip about 165 miles of road.

The Panama Railroad, F. C. Boggs, General Purchasing Officer, Washington, D. C., received bids up to January 5 for 60,000 lbs. of spikes. (Req. No. 1342.)

RAILROAD STRUCTURES.

GALVESTON, TEX.—Press reports indicate that the Santa Fe has authorized the signing of the causeway contract. Vice-President and General Manager F. G. Pettibone is quoted as having said that actual work will commence within 60 days. (November 13, p. 1366.)

PORTLAND, ORE.—Plans are said to have been made for a new bridge over the Willamette river, to be paid for jointly by the city and the Oregon Railroad & Navigation Co. The new structure is to take the place of the present steel bridge, and is to be built from the end of Glisan street, on the west

side, to the intersection of Oregon and Adams streets, on the east side, and is to have a height of 62½ ft. above high-water. The bridge is to be about 1,700 ft. long.

Tacoma, Wash.—The Chicago, Milwaukee & St. Paul has given the contract for the erection of the terminal freight house and platforms to the H. Chase Co., of Seattle, Wash. The structure will be built at Twenty-fifth and A streets, and will be 600 ft. x 500 ft., with a shipping platform on the north end 16 ft. x 150 ft. Work is to begin at once. (Dec. 25, p. 1666.)

Tulsa, Okla.—The Oklahoma State Corporation Commission has approved the plans of the Missouri, Kansas & Texas for a new passenger station to replace the one burned about a year ago. The station is to be of brick construction and will extend from Main street to Boston avenue. The improvements are to cost $40,000.

Vancouver, B. C.—Reports from Vancouver say that the Hill interests recently bought property costing $500,000 along the north shore of False creek, in Vancouver. The property is to be used jointly by the Great Northern and Northern Pacific for terminal purposes.

New Steel Barges for the Lehigh Valley.

The Lehigh Valley has just launched the first of a number of steel coal barges, which are being built to carry coal from the storage yards at Perth Amboy, N. J., to points along the eastern coast. Wooden barges have been used almost universally heretofore. The steel barge carries a larger load on much less draft than the old wooden barge and will tow much easier.

The dimensions of the barge just launched, which corresponds exactly with other barges being built for the Lehigh Valley, are as follows:

Length, over all	200 ft.
Breadth, over all	35 "
Depth of hold, lowest point of sheer	17 ft. 6 in.
Draft, loaded, 1,620 tons	14 " 6 "
Draft, loaded, 1,900 tons	17 ft.

It has watertight bulkheads in bow and stern, also three steel bulkheads for dividing cargo, the boat being divided into four bins, enabling shipments of four different kinds of coal in the same barge. It is provided with a donkey boiler, steam capstan, Baldt anchors, and large anchor chains of ample length. There are three masts, 76 ft. long, provided with three leg-of-mutton sails, enabling it to proceed under its own sail in case it breaks adrift from the tow boat. It is also provided with a modern lifeboat, in addition to a dory used as a workboat. The captain's quarters, located on the main deck, are finished in polished ash. The pilot house and the quarters of the crew are on the upper deck, making the barge one of the most complete now employed on the Atlantic coast in the coal trade.

British Patent Law.

An important decision under the new British patent law has been rendered revoking the patent for an American sewing machine in which a few minor parts were removed and replaced by parts made in England. The defendants pleaded that it was scarcely possible to manufacture the machine entirely in England owing to the lack of the necessary tools and the highly skilled labor that was essential, but the Comptroller-General of Patents ruled that the American patentees had not adequately worked the patent in England by merely making a small number of substituted parts.

Scherzer Lift Bridge in Burma.

The long bridge across the Ngawun river, India, on the main line extension of the Burma Railways from Rangoon to Kyngin was completed in December. This bridge is the largest in Burma, the total length being 820 ft., with a movable span 220 ft. long. The Ngawun river is in the fertile delta of the Irawaddy river and forms a connection between this river and the Bay of Bengal. The government required the large movable span to expedite railway traffic and the heavy river traffic of the Irawaddy Flotilla Company, whose vessels traverse these waterways from the coast to the interior of Burma as far as Mandalay, more than 400 miles. The bridge was designed by the Scherzer Rolling Lift Bridge Co., Chicago, and made in England at the works of Spencer & Company, Melksham, Wilts. It was erected in Burma under the charge of the engineers of the Scherzer company. Though the difficulties were great, the bridge was built within a year. During the rainy season, extending from May to October, the river was subject to great floods. During the dry season several hundred natives died from an epidemic of Asiatic cholera.

Supply Trade News.

Arthur L. Stevens, industrial and furnace engineer, has taken a position in the Rockwell Furnace Co., New York.

Hereafter the department of Track Devices of the Quincy, Manchester, Sargent Co., Chicago, will be operated under the old name of The Q & C Company.

E. S. Van Tassel, formerly Trainmaster of the Colorado division of the Union Pacific, has taken a position in the New York office of Manning, Maxwell & Moore, New York.

T. M. Murray, heretofore with the Protectus Company, Philadelphia, Pa., has been appointed Eastern Sales Manager of the Arlington Manufacturing Co., Canton, Ohio, paint makers.

The Scullin-Gallagher Iron & Steel Co., St. Louis, Mo., will supply the bolsters for the 500 box cars recently ordered by the Delaware, Lackawanna & Western from the American Car & Foundry Co.

A. D. McAdam has been elected Vice-President of the Damascus Brake Beam Co., Cleveland, Ohio. He was formerly Auditor of the American Car & Foundry Co., and later Manager of Sales of the Michigan Malleable Iron Co.

J. S. Seeley, formerly Resident Manager at Denver, Colo., of the Galena Signal Oil Co., Franklin, Pa., has been appointed General Manager of the western branch of the Nathan Manufacturing Co., New York, with office in the Old Colony building, Chicago.

John N. Douglas, Supervisor of Materials, Scranton plant of the American Locomotive Company, has resigned and will devote his entire time to the affairs of the American Safety Lamp & Mine Supply Co., Scranton, Pa., of which he is Secretary and Treasurer. Brass car and locomotive fittings will be among the specialties of the company.

The Chicago Steel Car Co., Chicago, the incorporation of which was reported in our issue of October 16, has purchased the steel car department of the E. A. Bryan Co., Harvey, Ill., and will make a specialty of building steel tank cars. The officers are: President, L. H. Foster; Secretary, G. H. Gibson; Treasurer, W. H. Tucker. The offices of the company are in room 1018, First National Bank building, Chicago.

The Commercial Testing & Engineering Co., Chicago, has opened an office and laboratory in the Old Colony building, Chicago, as Consulting Fuel Engineer and Chemist. The company will specialize on boiler room economics, coal analysis, heat value method of purchasing fuel and coal washing and preparation for operators. Edward H. Taylor is President; Harry W. Weeks, Vice-President; W. D. Stuckenberg, Treasurer, and B. J. Maynes, Secretary.

The Raymond Concrete Pile Co., New York and Chicago, has recently established two new branch offices, one at 204 Perrin building, New Orleans, La., and another at 620 Chestnut street, St. Louis, Mo. The New Orleans office is in charge of G. B. Raymond, one of the sons of the late A. A. Raymond, inventor of the pile. Mr. Raymond will take care of all business in the southern states. The St. Louis office is in charge of Warren A. Tyrell, C.E., who has represented the Raymond company in that city for some time.

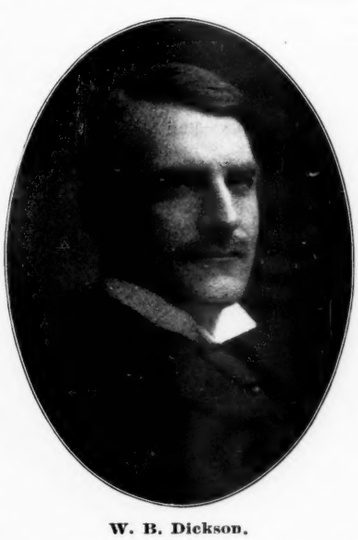
The Inter Ocean Steel Co., capitalized at $2,000,000, has been organized to make open-hearth steel locomotive and car wheel tires, other forged and rolled shapes, and also steel-

tired car wheels. W. L. Jacoby, formerly General Manager of the Latrobe Steel & Coupler Co., Philadelphia, Pa., whose works were at Melrose Park, Ill., is President of the new company. The plant, which will be at Chicago Heights, Ill., will be designed by Julian Kennedy. The shares of the new company are largely held by men prominent in railway and banking circles.

The National Malleable Castings Co., Cleveland, Ohio, has bought the stock of the Latrobe Steel & Coupler Co., Philadelphia, Pa., whose plant is at Melrose Park, near Chicago. This stock has been heretofore owned by the Latrobe Steel Co., which is in liquidation. As the last named company sold its steel tire plant to the Railway Steel-Spring Co., New York, some time ago, the Latrobe Steel Co. can now wind up its affairs. The Latrobe Steel & Coupler Co. will still be operated as a separate company, with the following officers: President, Albert A. Pope; Vice-Presidents, Henry F. Pope and John Havron; Secretary and Treasurer, John Henderson.

The Franklin Manufacturing Co., Franklin, Pa., has been given the contract for covering the Cunard pier of the Boston & Albany at East Boston, Mass., which was recently destroyed by fire, with reinforced corrugated asbestos sheathing. It also has the contract for covering with this material the elevator conveyor housings on top of the Clyde pier for the same company. The Clyde pier is the one which the fire did not touch, and the new elevator has been erected on top of it. The company also has the order for covering the Waterbury, Conn., train sheds of the N. Y., N. H. & H. with corrugated reinforced asbestos roofing. It is now getting out the material for all these orders and expects to start work at an early date.

William B. Dickson, as already mentioned in these columns, has been elected First Vice-President of the United States Steel Corporation, succeeding James Gayley. Mr. Dickson was born in Pittsburgh, Pa., in 1865, and started work in the Carnegie mills at Homestead, Pa., in 1881. He served there in a number of capacities, and later rose through minor official positions until in 1899 he was taken into partnership. At this time also he was given the position of Managing Director. In this office he was not directly connected with the sales department, but was in charge of the execution of orders after the business had been placed on the books, supervising in this department the relations of the mills to the customers. He was later made also Assistant to the President of the Carnegie Steel Co., in charge of buying pig iron and scrap. When the United States Steel Corporation was formed, Mr. Dickson went to New York as Assistant to the President of that company, and was afterwards elected Second Vice-President. His duties in the Steel Corporation have been particularly in connection with the supervision of the operating relations of the different subsidiary companies, such as the distribution of semi-finished products between plants. Part of his duties as First Vice-President will be those which he has been handling, but his jurisdiction is enlarged. No comment on this deserved promotion is necessary. Mr. Dickson's record and the recognition by the United States Steel Corporation speak for themselves.



W. B. Dickson.

The Northern Railway Supply Co., Chicago, the incorporation of which was reported in our issue of December 11, has its main offices in the Chamber of Commerce building, Chicago, with branch offices in New York, Cincinnati, Detroit and Toledo. The factories of the company are in Kansas City, Benton Harbor, Mich., and at Thirty-fifth street and Ashland avenue, Chicago. The malleable iron plant at Benton Harbor has recently been enlarged at an expense of $35,000 to provide facilities for an increasing business. Two of the specialties manufactured are the Rogers dust-proof journal box, adaptable to steam and electric cars, and the Neudeck steel grain door. The officers are: President, John F. O'Malley; Vice-President, A. W. Neudeck; Secretary and Treasurer, H. W. Drew.

Among orders recently received by the Link-Belt Company, Nicetown, Philadelphia, Pa., is one for a locomotive coal, ashes and sand station for the Philadelphia & Reading at Ninth and Wallace streets, Philadelphia. The plans of the station, which will eventually supersede the one now in use, call for reinforced concrete bins, supported by an under-structure of steel, covered with concrete. There will be 12 pockets for coal, two to each of six coaling tracks; total capacity, 2,000 tons. Ashes will be kept in two pockets having a capacity of 250 cubic yards. For sand storage there will be six hoppers, three on each side of station, to hold 48 cubic yards of sand. The conveying machinery comprises duplicate systems, and each will have a capacity of 100 tons per hour of coal, and of ashes 250 cubic yards in 10 hours. It is expected that work will be begun early in the new year. Other installations in Pennsylvania include elevating and conveying machinery at cement mills, paint works, hat manufactory and fueling equipment for a mining company. An open-top carrier will be installed for a contracting firm in New York, and an ashes hoist for a manufacturing concern in North Carolina.

TRADE PUBLICATIONS.

Missouri Pacific.—A folder contains a description of the "Gregory Tour" through Old Mexico, to leave St. Louis on February 2. Detailed information may be obtained from C. B. Gaussen, Passenger and Ticket Agent, Missouri Pacific-Iron Mountain Lines, St. Louis, Mo.

Machines and Small Tools.—The Cleveland Punch & Shear Works Co., Cleveland, Ohio, has issued a 40-page stock list of machines and small tools for the fabrication of iron and steel plates, shapes, etc. The publication contains a number of specification sheets for convenience in ordering supplies.

Dump Cars.—The Wm. J. Oliver Manufacturing Co., Knoxville, Tenn., has just issued an attractive catalogue on the Oliver all-steel dump cars. Both half-ton and line drawings of these cars are shown. The Oliver 20-yard dump car was illustrated and described in the *Railroad Age Gazette* of September 4, page 873.

Equipment for Central Stations.—Bulletin No. 5910-9, covering electrical equipment for central stations, has just been issued by the Western Electric Co., New York. This bulletin contains information regarding a.c. and d.c. generators, arc lamps and switchboards. A number of half-tone illustrations are also included.

Rubber Belt Conveyors.—The Jeffrey Manufacturing Co., Columbus, Ohio, has just issued catalogue No. 67-D on the subject of the Jeffrey Century rubber belt conveyors. The catalogue contains a large number of illustrations of installations, also a number of detailed illustrations showing the standard three-pulley carrier, troughing carriers, idlers, etc.

Concrete Mixer.—The Chain Belt Co., Milwaukee, Wis., has issued a catalogue descriptive of the chain belt concrete mixer which it manufactures. The company claims that the new features to be found in this type of mixer are an improvement over the various patterns now being used. A view of the plant of the Chain Belt Co. appears on the back page of the publication.

Laurentide Micanneal.

Steel becomes stronger and more uniform in structure by slow heating to high temperature and slow cooling. The requisites for successful results in this process are said to be but recently well understood. The most important among these are the correct ultimate maximum temperature and the very slow and uniform heating and cooling. To

secure this latter, a covering must be given to the steel in order to prevent rapid cooling and oxidation of the surface. A protective packing must be such as to allow the heat to pass through it slowly and also must not contain any constituents which are liable to affect the quality of the steel either through fusing or oxidation. This requires that the packing shall be infusable at the temperature used and shall not be capable of absorbing gases.

The Laurentide Mica Co., Ltd., Pittsburgh, Pa., has just placed on the market a product known as Micanneal, which is said to have proven itself an excellent packing. It is said to be infusable, that it will not absorb gases and that it is a remarkably good heat insulator; also that it prevents the steel from being heated or cooled too rapidly and protects it from oxidation. Specimens of steel come out clean and free from scale when packed in micanneal. Steel packed in this material is said to require from 25 to 150 per cent. more time to heat and to cool than with any other packing.

Electric Power Shovel Cost Records.

For a number of years, power shovels operated by electricity have been in successful operation in different sections of the country, for such work as digging ballast for electric railways, dry placer gold mining, etc., but until recently no accurate records of the cost of work done by such shovels has been attainable. There have now been gathered some accurate records of work done by one of these shovels digging ballast for the Chautauqua Traction Co., Jamestown, N. Y.

The shovel, which was made by the Vulcan Steam Shovel Co., Toledo, Ohio, weighs about 40 tons complete. The car body is 27 ft. long by 6 ft. 8 in. wide and is mounted on standard railway wheels. It is equipped with 1½ cu. yd. dipper which has a clear lift of 12 ft. with door open. It will make a 26-ft. cut at level of rails and will

Vulcan Electric Shovel.

dump out 21 ft. 6 in. either way from the center of the shovel. It is equipped with three separate motors, one for hoisting the dipper, one for swinging the crane and a motor on the crane for crowding the dipper into the bank. All motors are of the regular railway type, variable speed, d.c. 600 volts, 700 r.p.m.

In hoisting the dipper through the material, it will frequently strike hard material which would stall the motor and burn it out, while a motor strong enough to stand such strains without burning out would tear the dipper to pieces. This objection is overcome in the shovel under consideration as follows: The main or hoisting motor is 75 h.-p. and is provided with an automatic magnetic controller and a circuit breaker which will throw off the current as soon as the motor has exerted its maximum safety power. The important feature, however, is the series overload relay with which each motor is also equipped and which is to the motor what a governor is to a steam engine. As soon as the dipper meets any obstruction in the shape of hard material or boulders, this overload relay automatically relieves the motor of the excess current and prevents it being overloaded or burning out, no matter what the conditions of service are. When the crane or boom of any shovel is being swung, it acquires a momentum which if not checked in some way makes it drift around too far and thus is liable to do considerable damage to the structural part of the shovel. On a steam shovel this drifting motion is cushioned by slightly reversing the engines. On the electric shovel this momentum is taken care of by the solenoid brake, the clutch of which is thrown in by springs. When the current is turned on to the swing motor, it is automatically turned on to the mechanism of the brake also, energizing a magnet which throws back the springs and releases the brake. As soon as the current is cut off the springs throw on the brake, bringing the crane to an easy stop at any desired point, and without any reverse power being exerted by the motor. The swinging motor is 30 h.-p. and is also safeguarded with circuit breaker, etc. The crowding or crane motor is also 30 h.-p. and is provided with automatic controller, circuit breaker, overload relay, etc. It is safeguarded in much the same manner as the hoisting motor. In addition to this, however, it has a foot brake operated by the craneman, so that should the circuit breaker be automatically thrown out, as the result of overloads or other causes, the dipper can be held at any point desired.

The cost of the work referred to above is shown in the following extract from a letter to the manufacturers from A. N. Broadhead, President of the road: "A short time ago we placed an ammeter and volt-meter on the shovel for the purpose of ascertaining cost of operation per hour and hand you the enclosed memorandum. Of course the shovel did not work constantly during this time, owing to the shortage of cars; if we had been able to keep the shovel at work without a let-up, we feel sure the cost per hour would be materially reduced."

Cost of Power and Labor.

Cubic yards handled per hour	66⅔
1 man per hour	$ .33
1 man per hour	.25
2 men at $0.15 per hour	.30
20.346 k.w. hrs. at $.0088	.18
Oil and waste, estimated	.04
Total cost per hour	$1.10
8 hours at $1.10	$8.80
8 hours at 66⅔ cu. yds.	534 cu. yds.
$8.80 divided by 534 cu. yds.	$.0164 per cu. yd.

The material being dug was a mixture of gravel, sticky clay and sand, which was hard to handle, but, as will be seen from the above figures, the cost of this work was very low. There are several causes for this, the principal ones being: First, as the shovel required no boiler, the cost of a fireman and of hauling coal and water was eliminated; second, the work of the shovel was intermittent and when idle no power was consumed, as would be the case with steam shovel where steam must be kept up just the same. The shovel could have been operated to its maximum capacity, which would have given twice the yardage at nearly the same cost, as the men had to be paid whether they were working or idle, and the additional cost for power would not have been more than twice what it was, which, on the same basis, would mean 1,068 yds. at a cost of $10.24 or $.00958 per cu. yd.

Autogenous Welding With the Oxy-Acetylene Flame.*

Autogenous welding is a process uniting metals of the same nature by fusion at high temperatures, without the intervention of a different metal, as is the case in soldering or brazing. This welding is accomplished by use of a blow pipe, known as the oxy-acetylene torch.

The high temperature of the oxy-acetylene flame was discovered by M. H. Le Chatelier in 1895. In a note to the Academy of Sciences he presented his calculations, showing that with an equal volume of oxygen, acetylene would give a temperature of about 4,000 deg. C., or 72,000 deg. F., which is 1,000 deg. C., or 18,000 deg. F. greater than the temperature of the oxy-hydrogen flame. The first experiments were greatly impeded by the so-called flash back, which is caused by rapid propagation of the flame. It was not until 1901, six years after Le Chatelier had announced his results, that a practical torch was obtained.

There are three different types of oxy-acetylene torches, the high, low and medium pressure torches. The high pressure torch can be used only with both the acetylene and oxygen under pressure and the apparatus must be provided with positive check valves to prevent the gas of one container from going into the other. In cases of flash backs, these high pressure torches have become so heated that portions have been melted. Another defect of this torch is that as both the gases are under very high pressure they issue from the tip with very great force and it requires an expert to make a weld without blowing away the molten metal. The operator has perfect control of the mixture for the flame, being able to increase or reduce the volume of either gas.

The low pressure torch is used with the oxygen under pressure while the acetylene is taken at a much less pressure from an ordinary lighting generator. In this torch, the gas is mixed by injection, the acetylene being drawn into the mixing chamber from the surrounding chamber by velocity of the oxygen passing through it. As there is no means in this torch of forcing the acetylene, the operator must depend entirely upon the oxygen to secure the mixture. As the proper mixture is one part of acetylene to 1.28 parts oxygen and the mixture by the injector being problematical, a perfect flame is difficult to obtain and almost invariably there is too much oxygen and the weld is oxidized.

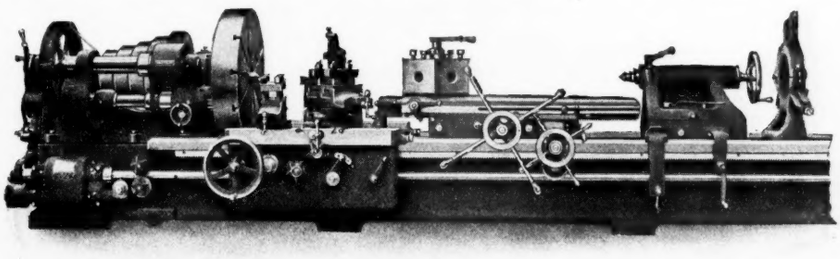
The medium pressure torch was devised to remedy, as far as possible, the defects of the other two types. This torch is made very similar to the low pressure torch, except that the mixing of the gases is

*From a paper read before the Technology Club of Syracuse, N. Y., November 17, 1908, by Eugene Bournonville, Vice-President, Davis-Bournonville Co., New York.

accomplished entirely in the nozzle or tip. This arrangement enables the operator, by simply changing the tip, to change the combination of gases, and to obtain a flame best adapted to the thickness of the metal to be welded, without changing the torch itself. An advantage which this torch has over the high pressure torch is that the mixing chamber and the aperture through the torch is about six times as large as the injector through which oxygen is introduced at 15 lbs. pressure and consequently the blowing force of the flame is not half that of the same size high pressure torch. In cases of flash backs, the flame cannot extend beyond the injector tip, therefore there is no injurious effect on the torch itself. In addition to changing the size of the flame without changing the torch itself, this torch does not depend entirely upon the injector for the proper mixture of acetylene, but both gases being under medium pressure, the flame can be adjusted to requirements. The flow of gas for a low pressure torch to give a stable flame must have a velocity of not less than about 330 ft. per second. For the reason stated, the medium pressure torch is the ideal tool for autogenous welding and the field of its application in metal working is almost unlimited.

36-Inch American Engine Lathe.

Recent developments in modern shop practice, together with the present extensive use of high speed tool steels, has made the ordinary engine lathe of the past inadequate to meet the increased duties of



36-Inch American Engine Lathe.

modern shops. To meet these changed conditions, the American Tool Works Co., Cincinnati, Ohio, has designed and built a line of new improved lathes, one of which is illustrated and described herewith.

The improved quick change gear mechanism provides 32 changes for feeding and thread cutting, the range of threads being from one thread in 4 in. to 16 threads per in., including 11½ pipe thread. The feeding range is 6.4 to 92 cuts per in. The feed or screw pitches obtained are multiplied through the compound gears, it being necessary to change only one gear on the quadrant for each additional thread. This arrangement gives flexibility to the screw cutting mechanism, making it possible through the introduction of certain gears to cut a large range of special worms or threads.

The bed is of deep section, very heavy and of a patent drop-V pattern, with cross box girders at short intervals its entire length. The bed is further strengthened by a rack cast in the center, for engaging the pawl of the tailstock. The headstock is built with triple gears and is firmly bolted to the bed. The cone has 5 steps, the largest of which is 20 in. in diameter by 4¾ in. on the face. The spindle is made of high carbon special steel accurately ground and has a 2⅝-in. hole through its entire length. The bearings are of phosphor bronze with improved oiling facilities. The triple gears are of the slip gear type, readily engaged by rack and pinion at the front of the head. The internal gear is planed integral with the face plate and the pinion is cut solid with the shaft. All the gears are of coarse pitch with wide face. Fifteen speeds are obtained in geometrical progression. The ratio of gearing is high and calculated for great power.

The tailstock is strongly proportioned, with large continuous bearings on the ways and is moved rapidly along the bed by crank and gear. It is provided with a set-over feature for turning tapers. The base is rigidly clamped to the bed and is further secured by a rack cast in the center of the bed. The spindle has exceptionally long travel and is actuated by a hand wheel and screw. The carriage is very heavy, especially in the bridge, due to the drop-V bed and has continuous bearings of 50 in. on the ways. This carriage is also gibbed to the bed through its entire length.

The apron is tongued, grooved and bolted to the carriage along its entire length. The longitudinal and cross feeds are reversed from the front of the apron. This feature is of special value on long beds where the operator is far removed from the head. All the gears and pinions are of steel and of wide face, coarse pitch and cut from solid metal with special cutters and bronze bushed where running loose. The bevel pinion is never disengaged, thus avoiding much trouble from breakage. The compound rest is fitted with taper gibs, and the top slide is provided with power angular cross feed with 13½-in. travel. The mitre gears are of steel cut from solid metal. This swivel is graduated and top slide and cross feed screws have micrometer dials. The back gears are automatically disengaged when slipping the pinion into internal gear and vice versa. The longitudinal feed of the carriage is controlled by a friction and the cross feed by a saw-tooth clutch. The feed box on the front of the machine beneath the headstock gives three instantaneous changes for feeding and screw cutting for each change of the gears on the quadrant.

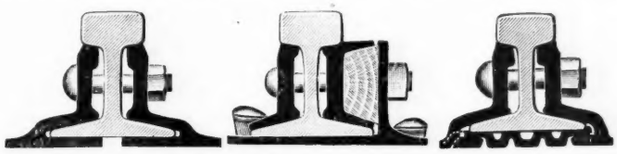
The turret on the shears is of a new design and has many valuable features. It is equipped with a new indexing mechanism, which is self-compensating for wear. This mechanism is placed at the front of the turret top slide which brings the locking pin very near the tool. The turret can be tripped or revolved automatically or by hand and the mechanism can be set so as to be inoperative, when wishing to run the slide back to the limit, without withdrawing the locking pin or revolving the turret. The top slide is supported on its outer end by a gibbed bracket attached to the front of the slide which travels along the V's of the bed and through the support of which any tendency to spring, due to the long reach, is eliminated. The bottom slide of the turret is moved along the bed by a wheel at the rear end. It is clamped to the bed by two eccentrics and further secured from slipping by pawl which engages a rack cast in the center of the lathe bed.

Eight feeds are supplied to the turret, ranging from .005 in. to .162 in., which are entirely independent of the regular carriage and apron feeds. The turret top slides may be quickly attached to the compound rest slide. This is a valuable feature when wishing to impart to the turret the feeds of the carriage, such as in large tapping operations. In this instance a positive lead is imparted to the tap, since the screw cutting mechanism can be engaged in the apron and the proper lead transmitted to the turret slide. This feature relieves the tap of all dragging at the start and the positive lead prevents the reaming tendency. The taper attachment is of heavy substantial construction, designed to eliminate all tendencies of the parts to bind which insures smooth and uniform action. It is supported on the bed and is supplied with a vernier attachment to facilitate fine adjustment.

Rail Joints.

The Rail Joint Company, New York, makes three forms of base supported rail joints. The advantage of the base support in a rail joint is primarily to give a proper area of support to the end of the receiving rail, which takes the blow from the wheel. The base-plate also adds to the stiffness of the joint, though all the designs illustrated herewith have also a large amount of metal disposed in the shape of angle bars.

The Continuous joint has the advantage of simplicity, there being no more parts than in an ordinary angle bar splice. It consists of two angle bars, with an extra broad bearing on the tie and with the lower flanges bent inward to form the base plate. In common with

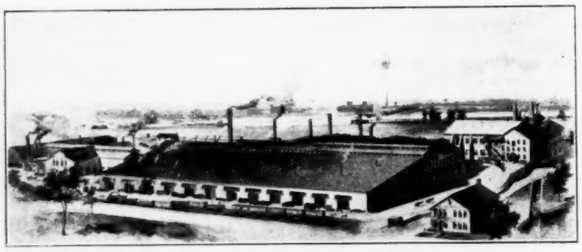


Continuous Joint. Weber Joint. Wolhaupter Joint.

the other two designs, this joint flashes with both the top and bottom faces of the rail flange. The Weber joint is made up of four parts, beside the bolts. On one side is an ordinary angle bar and on the other a channel, fishing into the rail in the ordinary manner. A wood filler fits into the channel bar to act as a cushion when the bolts are tightened. This block increases the elasticity of the joint, and deadens the noise from the wheel blows, and to some extent prevents the parts from working loose. The fourth part is an angle called the shoe angle, of which the vertical leg bears against the wooden block, while the horizontal leg serves as the base plate. The Wolhaupter joint consists of angle bars, the lower flanges of which are bent in to grip the corrugated base plate. This base plate has a shoulder along one edge to take the outward thrust, while on the inner side of the rail the plate and the angle bar are interlocked, the lower part of the angle bar being cut away at both ends, while the base plate is cut out at the middle. This is

indicated by the white dotted line in the illustration. The inside spikes are driven through holes punched through the base plate and bear against the edge of the rail flange where the ends of the splice bar are cut away. The fact that the base plate is shouldered gives it the advantage of a shoulder tie plate, in that the inner spikes help to hold the rail from spreading. In this joint all the bearing surfaces are inclined toward the center, so that by tightening up the bolts wear can be taken up and all the parts held tight against the rail.

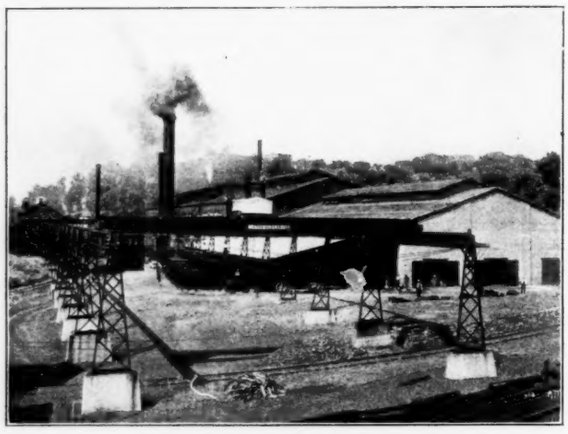
Within 14 years, the Rail Joint Company has put its rail joints in service on more than 50,000 miles of road. The company's plant is at Troy, N. Y. These works were originally the Albany Iron & Steel



Troy Plant; Rail Joint Company.

Works, where during the Civil War the plates for the Monitor were made. This plant has been almost entirely rebuilt. The steam rolling mill was recently enlarged, making the annual capacity 62,000 tons. The output of these works, however, is but a quarter of the entire output of the company, since the Illinois Steel Co., the Carnegie Steel Co., the Lackawanna Steel Co. and the Pennsylvania Steel Co. all make these joints for the Rail Joint Company. The company has distributing agencies in America, Canada and England.

The company's rolling mill is 430 ft. x 194 ft., while the storehouse adjoining it is 150 ft. x 79 ft. The yard is served by traveling cranes on a 610 ft. runway, whose span is 65 ft. On this runway are operated two 10-ton electric traveling cranes for carrying billets to the furnaces. The rolling mill is equipped with two 20-in., 3-high, roll trains, each served with an 8-ton jib electric train for rapid roll changing. There are also 10 finishing machines. The capacity of both trains in a single turn of 12 hours is 200 net tons a day, or about

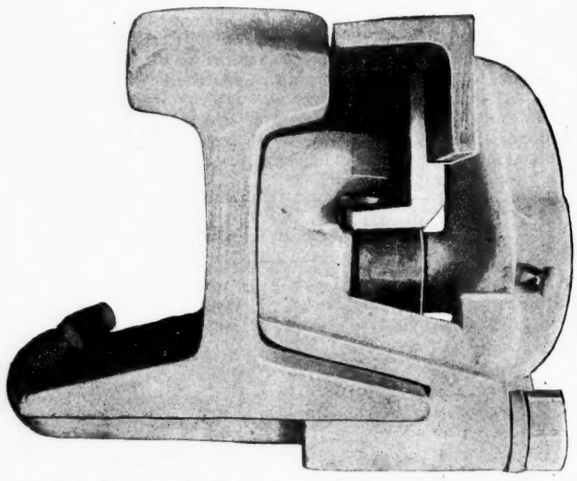


View of Troy Plant from North End.

62,000 tons a year. The boiler capacity is 1,500 h.p. and the capacity of the electric plant is 500 k.w. The roll shop is 136 ft. x 25 ft. and contains five modern roll lathes, motor driven. It is served by a 5-ton electric traveling crane running the length of the shop. The machine shop is fully equipped with lathes, planers, shapers, and all necessary tools for repairing any of the machinery in the plant or for building new machinery. The heating furnaces are so arranged as to be fed continuously while the trains are in operation, the raw material being carried from the yard by the electric cranes. The water power is a gravity system, fed from a storage of over 1,000,000 gallons on the company's property. The plant is connected with the New York Central & Hudson River by a mile of single track, while there are also facilities on the company's property for shipment by water. The general offices of the Rail Joint Company are at 29 West Thirty-fourth street, New York, and its officers are: President, F. T. Fearey; Vice-Presidents, L. F. Braine and Percy Holbrook; Treasurer, F. C. Runyon, and Secretary, Benjamin Wolhaupter.

Federal Switch Guard.

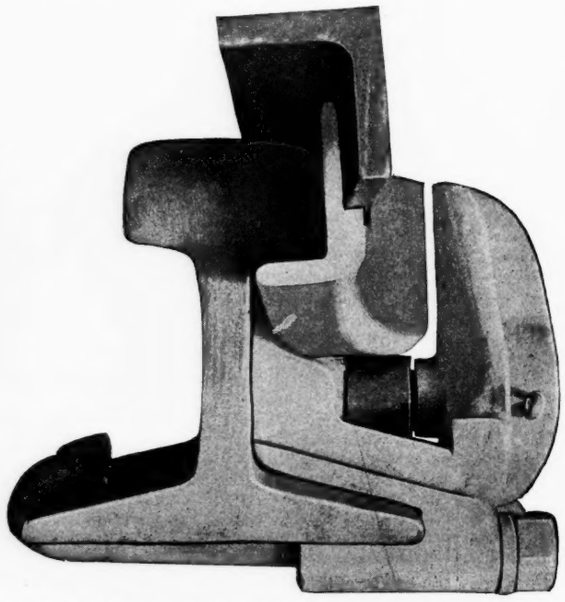
The Federal switch guard is a new device, designed to prevent throwing under the train of the switches controlled by an interlocking plant. The common detector bar is said to have proven unsatisfactory, especially on curves, with wide gage, narrow wheels treads and wide head rails. Attempts to make this bar effective in all cases have not proven entirely successful. When the various parts



End View of Switch Guard in Normal Position.

of the bar become worn, it will often fail to operate, since a very slight variation from normal conditions will permit it to slide up outside of the wheels of a passing car. Electric track circuits have also been used in attempts to overcome the unsuccessful operations in detector bars, although these have not proven entirely satisfactory.

The Federal switch guard has been developed to overcome the defects resulting in connection with detector bars and track circuits. As shown in the accompanying illustrations, the switch guard consists of an angle iron held in proper relation to the rail by guides. In normal position, the upper or horizontal leg of the angle has its edge in contact with the head of the rail and slightly below it. This



End View of Switch Guard in Raised Position.

angle iron must be raised above the top of the rail and then moved inward before the switch, to which the guard is attached, can be operated or even unlocked. The vertical motion necessary is ¾ in. and the horizontal motion 1 in. Another advantage is that the use of special rail braces are avoided and there is ample room between the vertical leg of the angle and the head of the rail for any rail brace. This switch guard is said to have been tested in service and that it is being installed on a number of important railways.